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ABSTRACT

This reference guide is designed to organize and suggest acceptable practices and procedures for dealing with safety in the area of biology instruction. It is intended as a reference for teachers, administrators, and other school staff in planning for science activities and in making daily safety decisions. Discussions deal with responsibility for safety, microbes, use of plant materials, use of animals, laboratory activities with humans, safety glasses, use of laboratory equipment and supplies, field trips, high risk experiments, special activities, emergencies, and recommendations. Numerous appendices deal with specialized considerations. (RE)

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OAKLAND COUNTY

SCIENCE SAFETY SERIES

REFERENCE GUIDE

FOR

BIOLOGY

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PREFACE

Teachers of science are in a unique position to assist students in understanding and appreciating the importance of safety education. Properly conducted classroom activities, experiments and demonstrations, can show their students how to anticipate and cope with the problems of safety in science. Good instruction can establish a school environment in which safety awareness and practice grows and becomes an integral part of the lives of our students.

With this in mind, the Oakland County Science Safety Series Reference Guides have been developed for the Biological, Chemical, Physical and Elementary areas of science. The Science Safety Series can provide teachers and administrators with specific information in answering questions on safety practices, problems and responsibilities that are most likely to occur in the areas of science instruction, and they also provide assistance in developing a safe laboratory environment that does not, at the same time, unduly restrict scientific inquiry, activity and attitude.

This "Reference Guide" is designed to organize and suggest acceptable practices and procedures for dealing with safety in the area of science instruction. It is intended as a reference for teachers, administrators and other school staff both in planning for science activities and making "on the spot" safety decisions.

It should be emphasized that this guide is only a starting point for good practices. In no way does it intend to establish universal laws, regulations or rules. The contents presented have no legal implications, and should not be read as legal requirements. It is strongly recommended that the reader determine the legal liability of teacher and/or administrator, as well as, pertinent local, state and federal laws and regulations. Further information on teacher liability can be found in Appendix A.

The working conditions of teachers are protected by the Michigan Occupational Safety and Health regulations (MIOSHA, Act 154 of 1974). Although MIOSHA regulations do not apply specifically to students, they do affect student laboratory safety conditions in an indirect manner. Further information on MIOSHA regulations can be found in Appendix B.

In addition, some school districts have operational statements concerning safety, and it is important that the administrator-teacher be aware of such policies and operating procedures as they relate to science.

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I. RESPONSIBILITIES FOR SAFETY

I. RESPONSIBILITY FOR SAFETY

Introduction

A district-wide science safety program must start at the highest level of administration and continue down through every level of the school community.

The members of the professional staff of the district must recognize and accept their moral and legal safety responsibilities and insist upon safe procedures in all science teaching areas.

Modern science instruction requires the active participation by the student. This raises safety questions not common to the more conventional course of study. Laboratory situations involving student participation are found at all grade levels.

One of the objectives of teaching science is to prepare students to function in a technological society. In such a society, a great many biological, chemical, and physical hazards exist. Therefore, it is natural that any instructional program will expose students to some potential dangers. It is the responsibility of the school to recognize these dangers, bring them to the attention of the students, and still allow the students to experience and discover the wonders of science.

Everyone involved in the administration, or teaching of a science program, should be aware of the federal, state, county, and local laws that apply to science teaching situations. (See Appendix for listing of Federal and State laws).

Safety involves positive goals. The development and operation of a working safety program requires the active participation of all members of the educational community.

A. ADMINISTRATION

In order to achieve district or school safety goals the administration should:

1. Actively support and display a good attitude toward school safety. Interest must be vocal, visible, and continuous.

2. Establish a written district-wide safety policy and program.

3. Stress and enforce the district-wide safety policy. Hold in-service education sessions with the teachers of science concerning the district-wide safety policy and program. This should include first-aid, fire prevention, general student protection (including personal protective equipment), and new safety procedures and considerations. This may mean the appointment of a safety committee and/or safety officers.

4. Be aware of rules governing teacher liability for classroom accidents, and include this topic in in-service and orientation sessions.

5. Assist and encourage the teacher to correct and avoid situations that could result in liability to the teacher and the school.

6. Provide for proper safety equipment in all science laboratories as directed by MIOSHA regulations.

7. Delegate responsibilities to the staff and ultimately to the students. Hold staff accountable for safety practices in their respective areas.

8. Analyze accident records in order to determine the most frequent causes of accidents and the more severe types of accidents. Take corrective measures to change accident-causing conditions.

9. Make safety literature, posters and safety promotional material available to all persons associated with the safety program.

10. Set up a program for the safety orientation for new personnel.

11. Instruct the maintenance department in the proper handling and disposal of science materials.

12. Overcrowding of classes should not be allowed in science laboratories. Consideration of whether overcrowding exists should take into account the physical size of a room, the arrangement of the furniture and the facilities in the room, the kind of activities that are being carried out in the room, and the number of students in the class.

13. Designate a safety officer for the science department.

B. TEACHERS

The real key to safety in the science class is the teacher. The teacher is responsible for being the leader in demonstrating and correlating safe practices in the science areas. The teacher should:

1. Be aware of the district-wide safety policy. Become familiar with implications of MIOSHA regulations as they apply to teaching duties.

2. Adhere to the district-wide safety policy as it applies to the teacher and the students under his supervision.

3. Enforce district-wide safety procedures. This can be carried out by requesting a student practicing an unsafe act or creating an unsafe condition to promptly correct the hazard. Failure to comply could result in suspension or cancellation of lab privileges. Report MIOSHA violations to the proper administrator.

4. Understand the teacher's relationship to the system-wide safety committee or safety supervisor.

5. Maintain safe working conditions, promote safe working methods, enforce the use of personal protective equipment and regulations, and establish the proper attitude toward safety in the classroom. The teacher should have the authority to close down a laboratory for a day, if he feels the environment is hazardous to the students' well-being.

6. Know his areas of responsibility and authority in the area of safety. Be aware of the teacher's total responsibility in terms of operations, machines, personnel, maintenance, repairs, working conditions, and accident reporting.

7. Notify the administration of any potential hazards. Do not allow students to work under unsafe conditions.

8. Determine the qualifications for student assistants. Supervise student assistants.

9. Be aware of the safety considerations for each laboratory activity and instruct the students in this area prior to the start of each exercise.

10. Do not allow the students to experiment on their own without proper supervision.

11. Make safety suggestions to administrative safety supervisor.

12. Review all laboratory manuals to determine the type and extent of hazards introduced by the various experiments and procedures. Analyze all laboratory experiences for possible safety hazards prior to introducing the material to the students.

13. Read and post safety literature, posters and safety promotional material.

14. Assist new teachers in learning and using the school safety code.

15. Know the location of and be able to properly use all science safety devices.

16. Do not work alone in a science laboratory and do not allow students to work alone.

17. Pretest all devices and/or equipment brought into class by a student prior to allowing students to use such devices.

18. Consult people with special knowledge or experience if unsure about using a new technique, chemical, or equipment.

C. STUDENTS

Accidents can be prevented only by each individual working in the laboratory in a safe manner. The students should:

1. Follow the general safety policies of the school district.

2. Maintain safe working conditions as they apply to the individual and the group. Use personal protective equipment and follow personal protective regulations.

3. Be aware of the safety considerations for each laboratory activity prior to the start of each exercise. Follow the safety instructions while performing the laboratory exercise.

4. Survey the student work areas in order to anticipate potential hazards and then take preventive measures and/or report such hazards.

5. Make safety suggestions to the teacher or safety supervisor.

6. Read, learn and follow the safety materials that are posted in the science room.

7. Not work alone in a science laboratory, or experiment on their own without proper supervision, not use unfamiliar equipment.

8. Report all injuries to the teacher immediately regardless of how minor.

9. Learn to use science equipment correctly and safely. Work in such a manner that other students are not placed in a potentially dangerous situation.

10. Completely clean up all work areas at the completion of an exercise or laboratory period.

D. MAINTENANCE

The maintenance department of a district or school also has a role in the safety program. The maintenance department should:

1. Be aware of the district-wide safety policy.

2. Establish the maintenance of science areas as a high-priority item. Some responsible person should periodically inspect the science teaching areas for such maintenance items as gas leaks, storage problems, electrical outlets, safety signs, and any other potential hazards.

3. Learn the proper handling and disposal of science materials.

4. Keep all science areas equipped with the necessary science safety materials.

5. Be certain that the science equipment is secure during non-class hours after school, and at night. This is especially important if the school building is used after the end of the normal school day.

II. MICROBES

REFERENCE PAGE FOR MICROBES

No pathogens should be used in classrooms. For Regulations governing these materials, see Registration of Laboratory Facilities, page 8.

Treat all microorganisms as if they are pathogenic. Read Statement of Hazards, page 8.

In dealing with microbes use proper techniques. For a list of safety techniques see Precautionary Measures, page 8.

Teachers should be aware of certain dangers in taking soil and water samples. See Precautionary Measures #'s 15, 16, page 9.

II. MICROBES

A. INTRODUCTION

Safety should be the prime consideration for those who work with microorganisms in the high school laboratories.

High school students should not work with known pathogenic organisms. If for some reason an investigation is undertaken which involves the use of pathogenic organisms, the laboratory must be registered in compliance with Public Act 308 of P.A. 1927.

B. REGISTRATION OF LABORATORY FACILITIES

Public Act 308, P.A. 1927 Michigan Department of Health (3500 N. Logan Street, Lansing, Michigan). Requires the registration of all laboratory facilities utilizing pathogenic microorganisms.

For further information on Public Act 308, it is suggested that the local Department of Health office be contacted.

C. STATEMENT OF HAZARDS

In all laboratory activities involving the study of microorganisms the following rule should be followed:

> Treat all microorganism cultures you use in microbiological studies as if they were pathogenic.

A listing of the scientific names of pathogens would be exhaustive and of little service to most teachers. Certain microorganisms which are considered non-pathogenic may cause problems to some people. Susceptibility is of such a peculiar nature that it would be rather difficult to identify all those microorganisms that are pathogenic or non-pathogenic. If you have any doubt as to usage of a particular microorganism contact the State Department of Public Health.

D. PRECAUTIONARY MEASURES FOR WORKING WITH MICROORGANISMS

1. Provide proper safety education and follow proper techniques in handling cultures. Pre-labs should include a warning of all hazards. See the references for techniques, or seek advice from colleagues, universities or trained personnel such as county agencies.
2. Insist upon proper use of equipment such as autoclave, pipettes, and inoculating needles: never transfer media with a mouth pipett. Flame all inoculating needles before and after transferring bacteria.

3. Clean the laboratory before and after laboratory exercise: Wash down work area with disinfectant - 5% Lysol solution - before and after transfers are made.
4. Autoclave old cultures prior to disposal or at least place them in a strong disinfectant. Don't allow old cultures to accumulate in lab or student drawers. All wastes should be burned - not thrown in wastebasket. Do not use dishwashers as a sterile technique in place of an autoclave. Do not let students operate the autoclave.
5. Care should be taken that spores and pollen are not excessively distributed through the classroom by tapping petri dishes, etc. If petri dishes are passed around they should be scotch-taped together.
6. Wear a laboratory coat or apron to protect individuals from accidentally contaminating their clothing. Keep hands away from mouth, nose, eyes, and face.
7. Keep table tops clear of all materials (purses, lunches, books) except those needed in the investigation. Limit the area being used.
8. Never eat nor drink in the laboratory. Do not store food (lunches) in refrigerators housing microbes.
9. When bacterial cultures are accidentally spilled, use proper disinfectant procedures in cleaning up the spill. Cover area with strong disinfectant and allow to stand for 10 minutes or longer.
10. Care should be taken to insure that petri dishes or other containers of nutrient media are not exposed to contamination through careless activity, coughing, or being left open for extended periods of time.
11. In accepting free gifts from hospitals, etc., be sure they are decontaminated. Throw broken slides away.
12. If sampling for bacteria be cognizant of the presence of tetanus in soil, and typhoid and botulism in standing water (ditches, etc.).
13. Bacteriological experiments should be performed by the teacher prior to classroom use.
14. Provide proper disposal containers - separate containers, for glassware and metal, paper, fecial waste, microbes, etc.
15. In taking soil sample of bacteria be aware of tetanus microbes - be cautious of working with breaks in skin.
16. In taking water samples for bacterial plates - be aware of other organisms that can be found in stagnant or polluted waters, e.g. schistosomaasis in ditches - causes swimmer's itch.

E. FIRST AID

Clean any break in skin with soap and water. If more serious get medical assistance.

F. REFERENCES

Benson, Harold J., Microbiological Applications A Laboratory Manual In General Microbiology. Dubuque, Iowa: Wm. C. Brown Company Publishers, 1973.

Crum, Lawrence E., Classroom Activities and Experiments For Life Science, West Nyack, New York: Parker Publishing Company, Inc., 1974.

Knudsen, Jens W., Biological Techniques Collecting Preserving, and Illustrating Plants and Animals. New York, New York: Harper and Row

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Morholt, Evelyn, Paul F. Brandwein, Alexander Joseph, A Sourcebook for the Biological Sciences. New York, New York: Harcourt, Brace and World, Inc., 1966.

III. USE OF PLANT MATERIALS

REFERENCE PAGE FOR USE OF PLANT MATERIALS

In certain laboratory situations students have been asked to make a selection of plants as samples. This should be discouraged. For a list of dangerous plants, see Poisonous Plants, page 12.

In case of consumption of a poisonous plant, see First Aid, page 13. Additional help may come through metropolitan poison control centers. See Chapter XIII Emergencies, page 56.

Teachers should be aware that using seeds and pollens may cause certain allergeric problems to some students, see section E Seeds, page 14, F Pollen and Spores, page 14.

Chlorophyll extraction should be done carefully. See page 14.

Follow instructions if you use pesticides or other plant chemicals. See page 14.

III. USE OF PLANT MATERIALS

A. INTRODUCTION

Most high schools have plants in classrooms, greenhouses or schoolyards, or take field trips to study plants, but very few students recognize poisonous plants and parts of plants that are poisonous to them. Proper recognition of plants and proper use of fertilizers, insecticides, fungicides and growth hormones will lower the potential danger in using plants in classrooms. Teachers should be aware of the fact that many students have allergies to plants and animals, in some cases the students may not even be aware of which plants and animals they have reactions to.

B. STATEMENT OF HAZARD

Since all plants have not been thoroughly researched for their toxicity, a common sense rule would be:
NEVER

1. Place any plant part in the mouth.
2. Rub any sap or fruit juice in the skin or open wound.
3. Inhale or expose your skin or eyes to the smoke of any burning plant or plant parts.
4. Pick any strange wild flowers or cultivated plants unknown to you.
5. Eat food after handling plants without first scrubbing your hands.

The above rules should be given as a pre-lab warning.

C. POISONOUS PLANTS

Be able to recognize plants and the danger from thorns, thistles and poisonous oils of plants.

SOME PLANTS KNOWN TO CAUSE REACTIONS

Apple trees - seeds
Autumn crocus, Star-of-Bethlehem - bulbs
Baneberry - berries
Black locust - bark, sprouts, foliage
Bleeding heart (Dutchman's breeches) - foliage, roots
Crab apple - foliage, seeds
Daphne - berries
Death camas - all parts
Dieffenbachia (Dumb cane), Elephant ear - all parts
Elderberry - all parts except fruits
English holly - berries
Foxglove - leaves
Golden chain - bean-like capsules in which the seeds are suspended
Honeysuckle - seeds
Horsechestnut - leaves, flowers and seeds
Hyacinth, Narcissus, Daffodil - bulbs
Iris - underground stems
Jack-in-the Pulpit - all parts, especially roots

Jessamine - berries
Jimson weed (thorn apple) - all parts
Lantana camary (red sage) - green berries
Larkspur - young plant, seeds
Laureis, Rhododendron, Azaleas - all parts
Lily-of-the-Valley - leaves, flowers
Maidenhair trees (Ginkgo biloba) - fruit
Marsh marigold (uncooked) - all parts, sap
Mayapple - green apple, foliage, roots
Mistletoe - berries
Monkshood (wolfsbane) - fleshy roots
Moonseed - berries
Mushrooms - all parts
Nightshade - all parts, especially the unripe berry
Oak trees - foliage, acorns unless properly prepared
Oleander - leaves, branches
Peach trees - leaves
Pear trees - leaves
Plum trees - leaves
Poinsettia - leaves
Poison oak, Ivy, Nettles, Common buttercup - all parts
Pokeweed - berries and roots
Potato - vines and foliage, green tubers
Privet, common - berries and leaves
Rosary pea, Castor bean - seeds
Rhubarb - leaf blade
Toadstools and related fungi - all parts
Tomato - vines, foliage
Water hemlock - all parts
White snakeroot - foliage
Wild carrot - foliage
Wild cucumber - seeds
Wild and cultivated cherry trees - twigs, foliage
Wild radish - flowers, fruits, stalks
Wisteria - seeds, pods
Yew - all parts

D. First Aid

In case of consumption of a toxic plant.

1. Contact doctor or poison control center immediately.
2. Save toxic plant for identification.
3. Examine mouth and throat.
4. If signs of inflammation or burning are present, do not induce vomiting. If inflammation and burning are not present, induce vomiting through one of the following methods.
   1. give 1 teaspoon syrup of ipecac (emetic made from a plant root).
   2. 2 teaspoons table salt diluted in a glass of warm water.
   3. a glass of warm soapy water.

   If victim is already vomiting, do nothing further.
5. Keep victim's head lowered so vomitus does not enter lungs.
6. Additional help may be (should be) obtained by calling the Poison Control Center nearest you. See First Aid, Chapter XIII, F, for listing, page 56.

E. SEEDS

Students frequently work with seeds. Many times unconsciously seeds are placed in their mouths. There is danger in this practice, not only from swallowing a dangerous specimen but from seeds coated with hormones, fungicides, and insecticides. THE REMAINDER ARE USUALLY DEADLY IF INHALED OR INGESTED. IN PURCHASING SEEDS FROM DEALERS, TEACHERS OUGHT TO INVESTIGATE THE PRESENCE OF ANY SUCH CHEMICAL COATING.

F. POLLEN AND SPORES

Pollen grains and the spores of many fungi, when inhaled by students conducting simple observations, have resulted in bronchial inflammation. Nectar and sap from blossoms can be especially toxic. Even excessive or prolonged exposure to bread and fruit molds can create an allergic response.

G. CHLOROPHYLL EXTRACTION

Chlorophyll extraction followed by chromatography study is a popular laboratory exercise. When alcohol is used it should be heated in a water bath. SOLVENTS SHOULD NEVER BE HEATED OVER AN OPEN FLAME. Solvents used in chromatograms should be used in a well-ventilated room. They can induce nausea, headache and other symptoms indicative of more serious consequence. Acetone is a common but toxic substance used in typical experiments. Ether is another. Ninhydrin reagent, frequently used should be used with extreme caution.

H. PESTICIDES, INSECTICIDES, FERTILIZERS

If you use any chemicals for plant work, always follow the manufacturer's instructions to the letter. Fumigants need particularly careful handling. The chemical DDT, Dieldrin and Chlordane are outlawed and considered dangerous to use. New chemicals for controlling insects and diseases are constantly coming on the market. Follow the recommendation of the County Extension Agent on the pesticides to use.

Precautionary Measures

1. Proper labeling of all chemicals is mandatory. See Chapter IX, H on labeling of chemicals. Read the label.
2. Keep pesticides in original containers and keep them tightly closed.
3. Always wash your hands and face after using pesticides and remove exposed clothing.
4. Never leave aquarium exposed and be sure to keep animals out of treated area until spray mist has completely settled.

These three posters from the U.S. Department of Agriculture show examples of safe practices that should be followed when you use pesticides around the home.

5. Teacher should supervise the use of any such chemicals.
6. Chemicals must be stored in a locked cabinet. Properly dispose of old or forbidden chemicals.
7. If a student swallows or there is eye contact with chemical, immediate action must be taken.
8. If skin is exposed, flush area and watch for burning or an allergic reaction . Report to office.
9. Use protective masks, gloves, eye glasses, etc., when necessary.
10. Proper ventilation is important.

I. GROWTH HORMONES OR PLANT GROWTH SUBSTANCES

1. Gibberellic Acid
2. Indole Acetic Acid
3. Indolebrityric Acid
4. Maleic Hydrazide
5. Naphthalene Acetic Acid
6. Phosor
7. Rootone
8. Colchicine*

The previous listed substances should be handled with extreme care. Persons should use rubber gloves to apply. *Colchicine is extremely poisonous and must be handled with all due regards to these properties.

J. References

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IV. USE OF ANIMALS

REFERENCE PAGE FOR USE OF ANIMALS

There are certain laws governing the use of animals. See Policy, page 17 .

Proper guidelines should be followed when using animals. For a list of guidelines, see page 18 .

Warm-blooded animals may involve different handling than cold-blooded animals. For a list of precautions on warm-blooded animals, see page 18 , for cold-blooded animals, see page 19 .

Animal bites always pose a hazard in handling animals. Some Precautionary Measures are found on page 20 .

Teachers should be vitally aware of diseases and parasites in association with animals. For a listing of diseases carried by animals see page 21 , and Appendix G, page 69 .

The formaldehyde used in preserved specimens must also be handled with care. For guidelines on the use of this chemical, see page 21 .

IV. USE OF ANIMALS

A. INTRODUCTION

One of the most pleasant aspects of teaching biology to students is the out-of-doors environment created in the laboratory by the presence of many living animals. Students are naturally attracted to animals and respond to them individually as pets. However, every animal is a potential threat to a student or teacher who handles it. This is particularly true of mammals.

B. POLICY: LAWS GOVERNING ANIMAL USE

Licensing by the State Public Health Department is required by everyone in the State of Michigan keeping animals for experimental purposes. Experimental purposes, as defined by the State Health Department, relates to the manipulation of the animal in any manner. Merely keeping an animal for the purpose of observing its normal growth and development would not be considered as manipulation. The term animal is generally construed as meaning a warm-blooded animal for the purpose of the licensing requirement. Such activities as hatching chicken eggs in the elementary school classroom would not be considered under this licensing requirement.
REFER TO ACT 241 OF 1947. See Appendix D Federal and State Laws.

Warm-blooded animals being used for experimental purpose should be registered under the Human Use of Animals, Act 241, P.A. 1947, Michigan Department of Public Health.

Federal laws concerning animals that may apply to school situations: Animal Welfare Act of 1970 - Pursuant to the Act of August 24, 1966, Public Law 89-544, as amended by the Public Law 91-579, provisions are made to protect the owners of animals, from the theft of their animals, to prevent the sale or use of animals which have been stolen, and to insure that certain animals intended for use in research facilities or for exhibition purposes or for use as pets, are provided humane care and treatment. The law provides for regulating the transportation, purchase, sale, housing, care, handling, and treatment of animals used in research, for exhibition, and other purposes.

Endangered Species Conservation Act of 1969. This Act was established under Public Law 91-135, December 5, 1969. The purpose is: to prevent the importation of endangered species of fish or wildlife into the United States; to prevent the interstate shipment of reptiles, amphibians, and other wildlife taken contrary to state law; and for other purposes.

C. STATEMENT OF HAZARDS

Since humans may contract diseases from animals, teachers and students should take such precautions as necessary to minimize the chance of transfer of pathogens from animal carriers.

The following principles should be followed to keep the maximum health for the animals and assure the safety of students and teachers:

1. All animals used for experimental purposes must be lawfully acquired and their retention shall be in strict compliance with federal, state, and local laws and regulations.
2. All laboratory animals must receive consideration for their comfort, they must be kindly treated, properly fed, and their surroundings kept in a sanitary condition.
3. Animal cages or containers should be so constructed as to avoid any possibility of animal bites to students.
4. If the students are to handle the animals, they should be taught to handle them properly and to teach reverence for life in any form.

D. GUIDELINES - REGULATIONS FOR EXPERIMENTS WITH ANIMALS

People naturally love animals. Teachers can utilize the rewarding learning experiences animals have to offer. Care must be taken, however, to insure that any animal is treated in a humane manner. Federal, state, and local laws must be observed when housing animals in the classroom.

Occassionally, students may inadvertently transmit shock to fellow students, parents and neighbors by exaggerating animal experimental procedures. They in turn could drastically affect the science program with feeling based on misunderstanding or ignorance of the true nature of the experiment.

1. The basic aim of scientific studies that involve animals is to achieve an understanding of life, and to advance our knowledge of life processes. Such studies lead to a respect for life.
2. A qualified adult supervisor must assume primary responsibility for the purpose and conditions of any experiment that involves living animals.
3. If pain is involved in any experiment, the animal must be under appropriate anesthesia. Animals must not be put under undue stress.
4. The comfort of the animal used in any study shall be a prime concern of the student investigator. Gentle handling, proper feeding and provision of appropriate sanitary quarters shall be strictly observed at all times. Any experiment in nutritional deficiency may proceed only to the point where symptoms of the deficiency appear.
5. Experiments with animals can have damaging psychological effects on a student. Teachers are urged to empathize with this situation. Some students may become dizzy or faint.
6. The teacher or qualified lab assistant should pith frogs, or sedate animals privately.
7. Disposal of used animals should occur after class and not in view of sympathetic pupils. See Appendix E Guiding Principles for Use of Animals in Elementary and Secondary Schools.

E. PRECAUTIONS - WARM-BLOODED ANIMALS

1. No experiment should be performed which will cause an animal pain, suffering, or discomfort.

2. No surgery should be performed on any living vertebrate.
3. Animal observations must be supervised by the teacher.
4. Food must be provided to maintain normal growth. Deficient diets should not be used except under proper supervision and never to the point of permanent harm to the animals.
5. Eggs receiving manipulation should not be allowed to hatch.
6. The animals should be housed in appropriate spacious, comfortable, sanitary quarters. Housing must be adequately secured.
7. Adequate provisions should be made for weekend care and vacation periods.
8. Mammals should be supplied by a recognized scientific supply company or supplier who has documentation indicating the organisms are free of diseases.
9. Wild animals of any kind should not be brought into the classroom.
10. Handle animals only when necessary - handling should be done properly, according to particular animal and under supervision. Wear protective clothing if needed. Keep animals away from face and mouth.
11. Special handling is required when an animal is pregnant, with young, hungry, or tired.
12. Never tease an animal, e.g., sticking fingers into cage.
13. Animal scratches and bites should be washed and reported immediately. The student should be sent to a physician. The animal should not be destroyed, it should be isolated for 10 days.
14. All wastes must be removed and disposed of in a safe and sanitary manner. No one with open cut or wound should handle an animal. Children allergic to animals should not be permitted to be near or touch animals.
15. Animals must be properly cared for in an emergency situation.
16. Physical separation of animals is sometimes necessary to prevent infectious diseases and to meet environmental requirements.

F. PRECAUTIONS - COLD-BLOODED ANIMALS

1. Wash hands after handling snakes, turtles, fish, frogs, toads, etc. Their habitat should be disposed of carefully. Turtles should be handled only when absolutely necessary. They carry salmonella, a disease lethal to man. A thorough scrubbing is mandatory.
2. After a period of observation, the animal should be returned to its natural environment.
3. Poisonous snakes, snapping turtles, disease-carrying insects, and harmful spiders should not be kept in the classroom.
4. Handling should be supervised and executed properly. Leather gloves may be utilized.
5. Housing should be kept clean and well ventilated. Optimum conditions for each species should be observed. Cages should be constructed to prevent escape and intrusion from students, etc.
6. Proper diet and water must be available.
7. Bites should be washed and reported to the office.
8. Keep animals away from face and mouth.

G. PREVENTING SPREAD OF DISEASES IN ANIMALS

1. House animals in clean, comfortable well-ventilated, well-heated quarters.
2. Clean drinking water.
3. Painlessly destroy sick animals.
4. Remove exposed animals to clean sterile cages.
5. Burn remaining bedding, food, etc.

6. Sterilize exposed housing.
7. Consult veterinarian.
8. Isolate new animals for at least 2 weeks.
9. Control insects and wild rodents.

H. SIGNS OF DANGER

1. Unusual odor from cage.
2. Animal is sluggish, unresponsive.
3. Constant bickering, fighting (don't confuse with pecking order).
4. Loss of appetite.
5. Hair, eyes or skin change color.
6. Unusual discharges.
7. Dead body or remnants in cage.
8. Frequent sneezing.

I. PRECAUTIONARY MEASURES FOR BITES, ETC.

1. Before a child is allowed to work with animals, there should be instruction in the proper method of handling and carrying.
2. Animals capable of inflicting a venomous bite should not be kept in the school building.
3. Report immediately all bites and scratches inflicted on students by animals.
4. Replace all damaged cages immediately.
5. If sick animals are found remove all sick or suspect animals, painlessly destroy them and consult a qualified veterinarian for treatment of healthy animals to prevent their becoming ill.
6. When examining insect collections, children and teachers have suffered violently after inhaling some protein flakes and scales from the wings of Caddisflies, moths, butterflies and mayflies.
7. To get a closer view of preserved poisonous specimens, they are occasionally taken from a bottle of preservative. It is not impossible to be scratched by the fangs of a dead rattlesnake. They can be deadly either way, dead or alive.
8. Many students have been bringing a variety of fish, sea urchins, etc. to the class upon returning from sunny vacations in the south. Although these animals ordinarily do not attack directly, each should be handled with care. An octopus can inflict a sharp wound. Many such wounds have been very painful infections due to the foreign proteins carried into the body during penetration.

   Allergic responses may occur to such things as seemingly harmless egg cases of whelks and the cluster of algae that may hide many marine worms. The symptoms are usually identified by itching, swelling of the hands and a slight headache.

9. Avoid unnecessary handling of wild mammals.

J. UNWISE TO:

1. Handle nursing females.
2. "Cure" an animal brought in by students.
3. "Mend" a broken bone.
4. Dissect an animal found along the highway.
5. Pet wild lab animals.

K. ANIMAL DISEASES

Potential danger exists with animals brought in by students who find birds, raccoons, squirrels, opossums, mice and others, that have been struck by a car or are otherwise too weak to escape a child's enthusiasm. Animal weaknesses may be due to an undetected illness. Animal diseases may include ringworm, rabies, rabbit fever and a host of others that can be carried by vectors parasitizing the weakened animal. Fleas may carry worms, which can be inhaled or swallowed by children. These may result in fatalities not associated with the prior handling of animals, including dogs and cats. Ticks and mites can fall into the clothing of a student and later attach themselves to creases and folds of the body. A few samples are listed below.

Organisms	Contact	Reaction
Dog hookworm	In soil samples (feces)	Creeping eruption
Schistosomaasis	Water samples (ditches)	Swimmer's itch
Ringworm	Dogs, cats, rodents	Ringworm
Ticks, fleas, lice, mites	Dogs, rodents	Disease carriers
Mosquito	Schoolyard, field trips	Infection, encephalitis
Tularemia	Rabbits	Rabbit fever
Tuberculosis	Primates	TB
Salmonella	Turtles	Salmonella, infection

For other diseases affecting man and animals see Appendix G, Diseases of Animals/Man, page 70.

L. PRESERVED SPECIMENS

Many lab specimens have been preserved in formaldehyde. This chemical may cause allergic or other reactions if exposed to the skin or inhaled. It is recommended that all preserved specimens have been thoroughly cleansed before handling. Proper ventilation should be provided. Preserved poisonous snakes should never be taken from the container. The venom is always toxic.

M. MAINTAINING RECORDS ON ANIMALS IN THE LAB

A biology teacher who uses animals for observation or experimentation should maintain records on these organisms. Such records may be helpful in demonstrating to parents or administrators that the teacher has attempted to insure that the animals under his supervision are cared for and safety considered. Sample records are found in the Appendix H, Animal Record Keeping, page 76.

N. REFERENCES

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V. LABORATORY ACTIVITIES WITH HUMANS

REFERENCE PAGE FOR LABORATORY ACTIVITIES WITH HUMANS

Students should never be forced to do experiments that may be injurious to themselves such as the common blood experiment. See Precautionary Measures, page 24 .

Other self-experiments involve physical activity and the ingestion of chemicals and foods. For statements on each of these topics see page 24 .

V. LABORATORY ACTIVITIES WITH HUMANS

A. INTRODUCTION

Some of the recent curricular developments in biology have suggested that certain exercises or experiments be performed by students on students, or that a student use himself as a guinea pig. At first glance, unless one is familiar with the procedure, this may seem a drastic means of learning. A second glance may point out the innocence of it. Only a third may prove the original hypothesis, but for other reasons - safety reasons.

B. STATEMENT OF HAZARDS

A teacher should recognize individual differences between students, and thereby plan any direct student-student experimentation with extreme care. No precautions are excessive or superficial when dealing with the well being of the student.

C. BLOOD EXPERIMENTS

Many different types of blood experiments or kites are being used by biology teachers, and if proper techniques are not followed wholesale infections with blood born diseases can occur.

The following precautionary measures should be taken:

1. No student should be required to type his own blood or submit to the procedure by academic coercion. Get parental consent notes if your community or school requires them.
2. Never use the automatic blood lancets. If one is in the laboratory it should be disposed of.
3. Use disposable type lancets and do not use more than once. Destroy lancet by bending and disposing.
4. Clean site of puncture with 70% alcohol and apply band aid over puncture after drawing blood.
5. Read teacher's manual for kits. Before any lancet is used, proper instruction must be given.
6. Tetramethylbenzidine for detection of blood inside living tissue should not be used because it is carcogenic agent.

The results of laboratory exercises in blood typing should never be taken as valid identification for a transfusion.

D. RUNNING IN PLACE AND INGESTION OF ORGANIC DYES

Having a student "run in place" to check a change in heart rate, should be done advisedly. This type of circulatory experiment can be done using invertebrates or it can be conducted using other small animals.

Ingestion of certain organic dyes which later appear in the saliva or urine may be an experiment in the laboratory. It may cause undue fright in a student or untold harm which may be apparent much later.

E. DIETS

Checking the results of restrictive protein and carbohydrate diets demonstrates effectively how this affects human by-products within a relatively short time. However, it may reveal a border-line diabetic or a similar condition in a student. This may be of questionable value at the particular time it becomes evident. The teacher bears the responsibility.

F. CHEEK CELLS

When removing epithelial cheek tissue for examination under a microscope: Students should be precautioned about gouging the check tissue. Toothpicks or sterile cotton swabs used to collect should be disposed of in special containers immediately after use.

G. REFERENCES

Safety in a Science Lab, Safety Education and Training Division, Bureau of Safety Regulation, Michigan Department of Labor, Lansing, Michigan, 1970.

VI. SAFETY GLASSES

REFERENCE PAGE FOR SAFETY GLASSES

Safety glasses are a must. See Statement of Hazard, page 27 .

Proper sanitation is required. Beware of contact lens. See page 27 .

Safety glasses should be used for all potentially dangerous experiments. See Precautions and Use, page 27 .

VI. SAFETY GLASSES

A. INTRODUCTION

Accidents in the science laboratory have injured, damaged or caused the loss of students' vision. Extreme caution must be observed to prevent such incidents. Therefore, in 1972, Michigan's legislators passed a law requiring the use of eye protection devices while using certain materials. The school must be prepared to obey such regulations while executing potentially dangerous experiments. It is the teacher's responsibility to comply with federal, state, and local laws. It is his responsibility to provide for the safety of his students.

With the advent of OSHA and its implications for student coverage in the future, schools are re-examining their limited use of personal protective equipment. While personal protective equipment in itself does not prevent accidents it can prevent or minimize injury.

B. STATEMENT OF HAZARDS

Eye Protection - The "Michigan School Code," (Act No. 269 of Public Acts of 1955). Sec. 585a. as applied to Biology reads:

1. Every pupil and teacher participating in a course shall wear industrial quality eye protective devices, which have been sanitized prior to use. The board of education shall furnish the devices for pupils, teachers and visitors to the laboratory. See Appendix I, Safety Glasses, page 79 .

2. Contact lens wearer - The exposure of the cornea to a normal supply of air is essential, it is therefore imperative that the air supply not be reduced further by working under a mask or hood. It is strongly recommended that regular eyeglasses are worn under the protective goggles or face mask instead of contact lenses.

C. PRECAUTIONS AND USE

1. A protective shield, (plexiglass, etc.) should be utilized during dangerous experiments.
2. Students should be seated far enough away from demonstration area to ensure safety.
3. Students should be equipped with eye protective devices when:
   a. There is danger of spattering or splashing (chemicals, shattered rock, etc.).
   b. Caustic or acid materials are being used.
   c. Explosive materials are present.
   d. Hot liquids or solids are present.
4. Eye protective devices must be checked regularly for defects.

5. They should be cleaned (sanitized) daily or after use. Beware of student looking at ultra-violet light in sanitizing cabinets.
6. It is important to remember that seemingly harmless situations are potential hazards. The teacher must use forethought in planning activities to provide for the safety of her/his students.

See Appendix I, Safety Glasses, page 79 , for types of safety glasses.

D. REFERENCES

Department of Education - State Board of Education - Eye Protective Devices.

VII. USE OF LAB EQUIPMENT

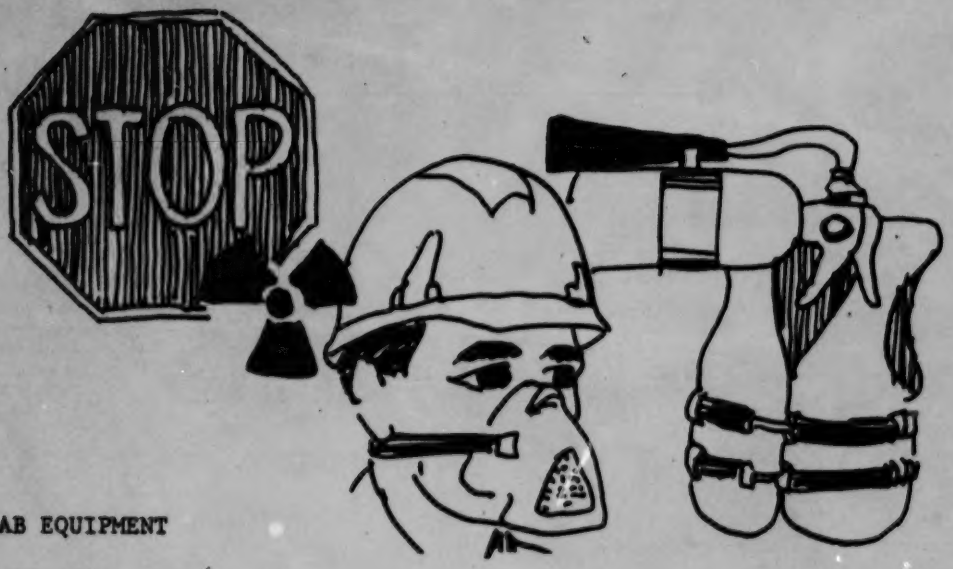
REFERENCE PAGE FOR USE OF LAB EQUIPMENT

Using sharp instruments or glassware are recurring situations in most labs. For a discussion of these tools, see Precautions, page 30 .

Open flames and flammable liquids pose fire hazards. See Precautions, page 31 , and Safety Checklist, page 31 .

Many forms of machines and tools are potentially injurious to the student's well being. See the Precautions on page 32 .

In Case of Fire, see page 32 .



VII. USE OF LAB EQUIPMENT

A. INTRODUCTION

Many times biology is the class where most students are first introduced to procedures, chemicals and equipment that can be dangerous to animals or humans, a teacher must be careful in his approach to the use of these items.

B. STATEMENT OF HAZARDS

Students are becoming more involved in lab experimentation. It is therefore mandatory that they know the proper use, care, and precautions taken with the equipment they are using.

C. DISSECTING EQUIPMENT - SHARP INSTRUMENTS - PRECAUTIONS

1. Before using any sharp instruments, the teacher must be assured that the students are competent to use such tools. Proper instruction and warning will avoid accidents.
2. Students should not carry instruments from experiment stations.
3. Handling and cutting should be done away from self.
4. Single edged blades should only be used. (razor blades)
5. Equipment should be stored in a safe area.
6. Special care should be taken when cleaning scalpels, scissors and needles.
7. Hypodermic needles should be stored in locked area. Used and disposed of properly.

D. GLASSWARE - PRECAUTIONS

1. Plastic apparatus is advisable where applicable.
2. Cracked or broken equipment should be discarded. (slides, etc.)
3. Glass apparatus should be stored safely.
4. Aquariums should be emptied with a siphon. Never move an aquarium filled with water. Do not handle glass wool without gloves.
5. Glass containers (aquariums, terrariums, etc.) should be placed in an area where they would not likely be bumped, jarred, etc.
6. Glassware which is to be heated should be only Pyrex or other heat treated glass.
7. All glass tubing used with rubber stoppers or corks should have beveled edges.

8. A soap solution or glycerine should be used as a lubricant when inserting corks or stoppers. The tubing should be wrapped in a cloth during insertion.
9. Corks should be removed to prevent adhering and "freezing."
10. Frozen stoppers should be removed by the teacher by splitting with a razor blade.
11. Glassware should be thoroughly cleaned after each use.
12. Broken glass should be swept up - smaller pieces can be picked up with pieces of wet cotton.

E. OPEN FLAMES - PRECAUTIONS

Many experiments in biology require the use of an open flame. It is good laboratory practice that no student experiment or teacher demonstration involving an open flame be performed without being preceded by a discussion of the correct procedures. Careful attention by the teacher to the problem and techniques of fire prevention and control may well save a student serious injury.

1. Candles - always place a metal tray or non-flammable pad under the candle. Watch out for the hot wax.
2. Alcohol lamps - place on a non-flammable pad. Use Ethyl Alcohol rather than Methyl Alcohol which has a lower flashpoint. Do not permit students to carry lighted burners from the working area. Adjust wick so that the exposed part is short and trim. Always tighten the top of the lamp before igniting and replace the metal cap top when lamp is not in use.
3. Bunsen burners - have the lighted safety match or friction lighter ready and bring it up to the burner before the gas begins to flow. Never turn on the gas before lighting the match. Check the hose connections frequently for gas leaks. Adjust air supply until you obtain a barely visible blue flame or non-luminous flame. Do not leave burning when not in use. Do not leave unattended once lit.
4. Portable or Propane Burners - Should be used by the teacher for demonstration and never used by the students. These propane burners contain liquified petroleum gas and should receive special care in handling and use. The flame is much hotter than that of the regular Bunsen burner. Have the lighted match or friction lighter ready and bring it up to the portable burner before the gas begins to flow. Never turn on the gas before lighting the match. Examine the burner frequently for gas leaks. When not in use - place it under lock and key. Dispose of empty cylinders in a proper fashion. Do not leave burning when not in use. Do not leave unattended when lit.

F. SAFETY CHECKLIST

1. No hanging or dangling clothing like tie, scarf, apron, sleeves, etc.
2. Long hair should be tied back in place.
3. Never light a candle or burner with a flaming piece of paper.
4. Keep flame out of draft of open window or door.
5. Keep flame away from edge of the table where it may tip and fall.
6. Keep flame away from a ledge, over hanging cabinet or shelf.
7. Always have a piece of metal under your flame.
8. Never deposit warm or burning material in trash basket.
9. Have a sand bucket nearby for matches, burned material, etc.
10. Teacher should know the location of the gas turn off valve in the case of bunsen burners. Test it frequently to make sure it is not frozen.

11. Most lab fires are the fault of carelessness, horseplay or an accumulation of combustible debris.
12. Intense heat may cause a student to burn his arm, clothing or hair.
13. Do not reach over an open flame.
14. Do not light one burner from another burner.
15. Check on the location of fire fighting equipment such as extinguishers, blankets, or sand. Locate fire alarm or fire exits in the event you have need of this information.

G. IN CASE OF FIRE

1. Don't panic.
2. Don't allow students to run.
3. Call for help.
4. Handle injured person as little as possible.
5. Be cautious rather than casual.
6. Be calm and deliberate.
7. Hair on fire!! Smother with blanket or jacket or roll on floor. Never use CO_2.
8. Clothing on fire!! Smother with blanket or jacket or roll on floor. Never use CO_2.
9. The danger in personal fires is that the affected student will seek his own aid and in a state of panic run about fanning the flames, thus magnifying the danger to himself.
10. The teacher must quickly determine the immediate and potential danger from the fire. If the fire presents a serious threat, then sound the fire alarm.
11. In the event of minor skin burns, do not apply grease or oil. Simply apply a sterile dressing and send student to the office.

H. FLAMMABLE LIQUIDS - PRECAUTIONS

1. Flammable liquids should be handled only under strict supervision.
2. They should not be used in any situation where sparks, flames, or excessive heat is present.
3. Appropriate extinguishers should be immediately available. See Appendix J, Fire Extinguishers, page 78 .
4. They should be stored in a cool, dry place (not a refrigerator).
5. Flammable materials should be kept in a locked metal cabinet.
6. They should be labeled with the following information:
   1. Common name.
   2. Solution %.
   3. Caution, warning, danger.
   4. Statement of hazards. Degree of hazard.
   5. Precautionary measures.
   6. Instructions in case of contact or exposure.
   7. Shelf life and date of aquisition.
   8. In case of fire - use preplanned procedure.

I. MACHINES AND TOOLS - PRECAUTIONS

Some experiments require the use of machines and tools. Proper utilization will not only increase their effectiveness but efficiency and safety as well.

1. Three pronged plugs should be used with all of them.
2. Avoid contact with moving parts or heating

elements. (hot plates)

3. The floor should be clean and dry where tools are being used.
4. Use each tool only for its intended purpose.
5. Students should use power tools only after they have received proper instruction on their safe use and then only under supervision of teacher.
6. Vacuum pumps without belt guards should not be used.
7. Know the proper procedure for using the microscope including electric phase scopes.
8. Many biology laboratories contain microtomes for the cutting of thin sections for microscope slide mounting. The blade is very sharp and should be well guarded.

9. Stoves, refrigerators, incubators, autoclaves, projectors, etc. should be operated with proper instructional safety.
10. Beware of a rapidly rotating centrifuge, a potential hazard to unsuspecting or overly curious fingers, dangling neckties, etc.
11. The use of garden tools such as snips, hoes, picks, trimmers, etc. should be well instructed and supervised.
12. Ultra-violet light - never look directly into light source. Radiation may be hazardous to retina. Only flourescent light sources should be used; never incandescent. The same precaution should be taken in regard to any activity using solar radiation.
13. Heat lamp (Infrared) - students should never touch or remain too close to bulb. A sufficient cooling time must be observed before touching bulb.
14. Other machines - it would be impossible to spell out every conceivable hazard.

In summary, suffice it to say that any laboratory device which has moving parts, cutting edges, sharp corners or other highly irregular shapes, heating elements or electrical parts, constitutes a potential hazard and should be so considered. A thoughtful, considerate teacher who is well adquainted with his equipment, is the best safeguard in a laboratory. Constant awareness provides the setting for maximum safety. For additional information see Appendix O, Safety Equipment and Facilities, page 88 .

J. References

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VIII. USE OF ELECTRICITY

REFERENCE PAGE FOR USE OF ELECTRICITY

There are many precautions one should take in dealing with electricity. For a list of Precautions, see page 35 .

Electrical shock poses probably the most important hazard. See First Aid suggestions, page 36 .

In case of fire, see page 36 .

VIII. USE OF ELECTRICITY

A. INTRODUCTION

Some experiments in the biology lab deal with electricity or utilize electrical equipment such as extension cords, lights, motors, etc. It is essential that the students be aware of safety precautions and cautioned against experimenting with electric current or devices that reach a high temperature during use and can cause severe burns when handled improperly. Never let defective electrical equipment be used.

B. STATEMENT OF HAZARDS

Whenever possible, experiments dealing with electricity, should be done with the use of dry cells rather than wet cells or AC current which could result in the child receiving a severe shock and possible rendering him unconscious.

C. PRECAUTIONS IN DEALING WITH ELECTRICITY

1. Never leave an open socket in which students can put their fingers or pencils, or loose wires that are live.
2. Electricity flows easily through some materials such as copper, aluminum and other metals.
3. Good insulators would be rubber, porcelain, bakelite and glass.
4. Do not overload a circuit by attaching too many appliances. This can overheat the wires. Outlets along one wall are in most cases on the same circuit and may result in an overload or "blown" fuse.
5. Inspect appliances and cords regularly. Discard cords that are badly worn or need new plugs.
6. Use plastic insulation tape for minor breaks in the cord. Not scotch tape or masking tape.
7. Do not touch switches, appliances or cords with wet hands.
8. In removing an electric plug from its socket, pull the plug, not the electric cord.
9. When inserting an electric plug, hold plug so that flashbacks due to a possible short circuit will not burn the palm of the hand.
10. Disconnect appliances when not in use.
11. Teacher should inspect and test the appliances and experiments before using them in class.
12. Bulbs and hot plates retain their heat so handle with care.
13. All electrical devices should be properly grounded.
14. When you overload or blow a fuse - contact the custodian.
15. When using machines with moving parts, beware of loose clothing and long hair. Any machine or appliance with belts should have a belt guard or not be used.

D. USE OF BATTERIES

1. Use dry cells rather than wet cells or auto batteries.
2. Dangers of an auto battery: it gives off gas, and may spill or acid may bubble and get in the eyes of a student.
3. Even a short circuited dry cell can produce a high temperature which

can cause a serious burn.

4. If a dry cell is cut in half, remember that the paste can cause skin and eye irritations.

E. FIRST AID - SOME SUGGESTIONS

1. A student can be severely shocked if electricity passes through his body. He may stop breathing and artificial respiration may be necessary. See Chapter XIII, Emergencies.
2. Burns from hot plates or hot bulbs should be covered with a sterile pad. Do not use grease or oil. Take student to the office.
3. Battery acid that splashes on a student should immediately be washed and flushed with lots of water.

F. IN CASE OF FIRE

1. In the event of an electrical fire, attempt to disconnect the source of current.
2. Use only CO_2 on electrical fires. Never use water, foam or soda acid. See Chapter XIII, Emergencies.

G. REFERENCES

Hone, Elizabeth, Alexander Joseph, Edward Victor, Paul Brandywein, A Sourcebook for Elementary Science, New York: Harcourt, Brace, and World, Inc. 1962.

Irving, James R., Provide for Safety in the Science Laboratory, NSTA Publication Stock No. 471-14576, 1968.

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IX. USE AND HANDLING OF CHEMICALS

REFERENCE PAGE FOR USE AND HANDLING OF CHEMICALS

The hazards of chemical use should be well known by all teachers. For a statement on this topic see Statement of Hazards, page 38 .

Certain chemicals are dangerous in handling either because some are classified as carcinogenic or when they combine with others form dangerous combinations, page 39 . For a list of carcinogens, see page 38 . For a list of Incompatible Chemicals see page 39 .

In case of ingestion call nearest poison control center. See First Aid in Chapter XIII, page 56 . Or if inhaled - report it immediately.

In case of fire use the proper fire extinguisher. See page 53.

Chemicals should be properly labeled. For an outline of this procedure, see Labeling of Chemicals, page 41 .

Chemicals must be handled with great care. For a list of guidelines see Precautionary Measures, page 40.

IX. USE AND HANDLING OF CHEMICALS

A. INTRODUCTION

Science teachers and the school community are becoming increasingly aware of the possible health hazards involved in using certain chemicals or chemical combinations in high school classrooms. An increasing number of diseases are being found to come from exposure to chemicals used years earlier.

B. STATEMENT OF HAZARDS

Teachers and students should take precautions against exposure to chemicals. Chemicals can enter the body by being ingested, inhaled or through the skin by absorption. There is no idea as to the number of cancer producing substances that are now considered safe. TLV (Threshold Limit Values) are being established for many chemicals. They will indicate the contaminant level to which persons may be exposed to a particular agent for specific periods of time, repeatedly, without adverse effects.

C. SAFETY RECOMMENDATIONS

This is suggested as a minimal recommendation for dealing with potentially hazardous chemical situations.

1. Inventory chemical supplies to uncover hazardous chemicals e.g. carcinogens, etc.
2. Unnecessary ones should be discontinued.
3. If retained they should be labeled as hazardous - see Appendix K for Labeling of Common Chemicals, page 79.
4. Develop a safe procedure for storage, use, disposal and supervision by qualified personnel.

D. CARCINOGENS

The following have definitely been established as carcinogens. It is very questionable whether these substances and their derivatives should ever be part of your inventory. Repeated small exposures to certain carcinogens can result in cancer.

Compound No.	Chemical	Chemical Abstract Registry No.
1	2-Acetylaminoflourene	53963
2	4-Aminodiphenyl	92671
3	Benzidine (and its salts)	92875
4	3, 3'-Dichorobenzidine (and its salts)	91941
5	4, Dimethylaminoazobenzene	60117
6	alpha-Naphthylamine	134327
7	beta-Nitrosodimethylamine	62759
8	4-Nitrobiphenyl	92933
9	N-Nitrosodimethylamine	62759
10	beta-Propiolactrone	57578
11	bis-Chloromethyl ether	542881
12	Methyl Chloromethyl ether	107302

13	4, 4, Methylene (bis)-2-chloraniline	101144
14	Ethyleneimine	151564
15	Asbestos	
16	Vinyl Chloride	
17	Chloroform	

Example - the dye Sudan IV is derived from Naphthylamine and is classified as a carcinogen.

For Disposal - WRITE FOR:
Laboratory Waste Disposal Manual; F.G. Stephen (Ed.) Manufacturing Chemical Association, 1969.
OR SEE APPENDIX O.

E. INCOMPATIBLE CHEMICALS

Figure 2: DANGEROUS COMBINATIONS OF COMMON SCHOOL CHEMICALS

Many substances which are not harmful themselves can become dangerous-toxic, explosive or flammable-when exposed to other materials. Care should be exercised in disposing of chemicals, as well as while using them, to see that hazardous combinations are not mixed.

The following combinations are among those described as incompatible in "Safety Alert," published by the Nassau County Science Supervisors Association. (Note that some chemicals not recommended for classroom use have been included because teachers who do continue to use them should be aware of the potential hazards).

Compound	Should not come in contact with:
Acetic acid	Nitric acid, peroxides, permanganates, ethylene glycol, hydroxyl compounds
Alkali metals, e.g., sodium and potassium	Carbon tetrachloride, carbon dioxide, water
Alkali metals, e.g., powdered aluminum and magnesium	Carbon tetrachloride, other hydrocarbons, halogens, carbon dioxide
Ammonium nitrate	Acids, inflammable liquids, metal powders, sulfur, chlorates, any finely divided organic or combustible substance
Bromine, chlorine	Ammonia, petroleum gases, hydrogen, sodium, benzene, finely divided metals
Chlorates	Ammonium salts, acids, metal powders, sulfur, any finely divided organic or combustible substance
Hydrocarbons, e.g., propane, benzene, and gasoline	Fluoride, chlorine, bromine, sodium peroxide
Hydrogen peroxide	Most metals and their salts, alcohols, organic substances, any inflammable substance
Hydrogen sulfide	Oxidizing gases, fuming nitric acid
Iodine	Acetylene, ammonia, hydrogen
Mercury	Acetylene, ammonia
Nitric acid (concentrate)	Acetic acid, hydrogen sulfide, inflammable liquids and gases
Potassium chlorate	Sulfuric and other acids, any organic substance
Potassium permanganate	Sulfuric acid, glycerine, ethylene glycol
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, carbon disulfide, glycerine, ethylene glycol, ethyl acetate
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate, similar compounds or other light metals

NOTE: There are thousands of incompatible chemicals. The above items are but a few of those most commonly found in high schools. Teachers who regularly handle less common materials should have in their possession for constant reference: MANUAL OF HAZARDOUS CHEMICAL REACTIONS (latest edition), National Fire Protection Association, 60 Batterymarch St., Boston, Ma. 02110.

F. SAFETY CONSIDERATIONS

Most accidents occur because of carelessness or ignorance. It is of utmost importance that the teacher be familiar with the properties of each chemical, precautions, and emergency procedures in case of an accident. Students must be competent and supervised while handling any type of chemical. If all safety rules are observed experiments involving the use of chemicals can be rewarding and enriching.

G. PRECAUTIONARY MEASURES - CHEMICALS

1. Warn students of potential dangers when working with chemicals that are poisonous or require special care in handling.
2. Teach respect rather than fear.
3. Wear protective aprons and safety glasses when there is potential danger from spills or splashes of harmful chemicals. Have eye wash facility in your room. Students should wash hands after using chemicals.
4. Make sure all flames in the laboratory are out when using flammable substances. (Alcohol, ether, etc.)
5. No eating, drinking, or smoking should be permitted in the lab.
6. An ABC extinguisher should be on hand when working with flammable chemicals.
7. Discard all broken glassware. Plastic containers should be used if applicable.
8. Teacher should conduct all experiments prior to students in order to familiarize himself with hazards.
9. Never have students carry glassware in congested areas.
10. Since many chemicals are potentially poisonous, all should be stored in a locked metal cabinet. See Appendix K, Chemical Containers, page 84.
11. Students should never taste, smell, or touch an unknown chemical.
12. All unmarked chemicals should be discarded.
13. A protective shield should be utilized during demonstrations where spattering may take place.
14. It is important to have all containers (bottles) permanently labeled. For Labeling of Chemicals see next section of this chapter.
15. Handle acids and bases with respect.
16. Don't allow spillage to remain on counters, floors, etc.
17. In working with gases remember that heat causes expansion-confinement of expansion causes explosion.
18. Avoid using asbestos gloves, and pads.
19. Ninhydrin, Chloroform, Alcohols, Ether and other vapors if used must be used in a fully ventilated area or in a hood. Mercury vaporizes slowly and is harmful. It can also be absorbed through the skin; it is a cellular poison.

20. Specimens preserved in formaldehyde should be thoroughly washed in running water for 24 hours. Also when dissecting the above specimens the room should be well ventilated because the fumes are dangerous to eyes, respiratory system, and skin. Many supply houses have preservatives that are much less harmful to work with than formaldehyde and should be used instead of formaldehyde.
21. Dry Ice - do not expose skin. Use in a well ventilated room as it produces CO_2. Use tongs in handling.

H. LABELING OF CHEMICALS

The labeling of chemical containers in high school laboratories is essential to safe operations. High school biology students are not familiar with the properties of chemicals; this is especially true in regard to their hazardous characteristics. Proper labeling can lower the potential for accidents occurring resulting in personal injury due to misuse, spills, etc.

Chemical labels should contain the following six kinds of information:

1. Name of chemical and concentration.
2. Degree of hazard.
3. Statement of hazards.
4. Precautionary measures.
5. Instructions in case of contact or exposure.
6. Date of purchase and shelf life.

1. Name of chemical. Not just the chemical formula.

2. Degree of hazard. This is indicated by the use of the appropriate signal word, DANGER, WARNING or CAUTION. The signal word calls attention to both the hazard and the relative severity. In terms of hazards, chemicals can be described as toxic, flammable, corrosive, irritating, sensitizing, carcinogenic, etc.

3. Statement of hazards. Some chemicals present more than one hazard; therefore, it is necessary to include each significant hazard present with the handling of the chemical. In certain instances, a minor hazard is explained in the precautionary measures recommended on the label. In a case where a material is considered to be a poison according to definite toxicity standards or where required by law, the term "Poison" is included in the label.

Examples of statements of hazard are:

CAUSES BURNS
EXTREMELY FLAMMABLE
VAPOR HARMFUL
EXPLOSIVE

4. Precautionary Measures. Precautionary measures are intended to be instructions which describe how users can avoid injury from the hazards given in item 3 above.

Example: Keep away from heat, sparks or open flame. Use only with adequate ventilation. Do not get in eyes, on skin, or clothing.

5. Instructions in case of contact or exposure. If accidental contact or exposure does occur, immediate treatment is often necessary to minimize injury. Such treatment usually consists of simple first aid measures which can be used before a physician can be seen.

   Example: In case of contact, flush with large amounts of water; for eyes, rinse freely with water for 15 minutes and get medical attention.

To apply the foregoing, the label for hydrochloric acid would be constructed as follows:

1. Hydrochloric Acid
2. Warning!
3. Causes Burns
4. Avoid contact with skin and eyes. Avoid breathing vapor.
5. In case of contact, immediately flush skin or eyes with large amounts of water for at least 15 minutes; eyes should get medical attention after flushing.

Because transferring a hazardous chemical from the original container to another container does not decrease hazardous properties, it is important to label the new container. Also, diluting or mixing of chemicals may call for label modification, and indicates the need for developing a new label. This, in addition to reducing the hazards associated with contacting the material will also lessen the possibility of mixing incompatible chemicals accidentally.

The orientation of new laboratory personnel and students to correct labeling is important since this not only reduces the possibility of injury, but also increases knowledge about chemicals that must be handled.

See Appendix J, Labeling of Common Chemicals, page 80.

I. REFERENCES

"Guidelines to Precautionary Labeling of Hazardous Chemicals"-Manual L-1, Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009.

Trenk, Barbara S., "Health Hazards in the Classroom" from American Lung Association Bulletin, J. 36: #4, 1977.

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Vol. 12, #5, May 1976
Vol. 13, #1, Jan. 1977
Vol. 13, #2, Feb. 1977

X. FIELD TRIPS

REFERENCE PAGE FOR FIELD TRIPS

Follow outlined procedure whenever out of the school building. Be prepared for emergencies. See Precautions, page 44 .

Report all accidents.

Take a first aid kit. See page 44 .

X. FIELD TRIPS

A. INTRODUCTION

Increasing usage of the outdoors as a laboratory for ecological studies or natural observations demands certain considerations on the part of sponsoring teachers. Many teachers who may be relatively inexperienced in conducting field trips should take precautions to insure the safety of the students involved. The following suggestions should be of value.

B. STATEMENT OF HAZARDS

Teachers should be sure to determine what the school policy is regarding injuries and emergency procedures to be followed on field trips for their school district.

C. PRECAUTIONS

1. School policy - use appropriate policy regarding consent slips, use of private transportation, licensed drivers, and filing anticipated schedule, reporting accidents, etc.
2. Students should be briefed on what can be expected. Define limits of area.
3. Outdoor activities must be supervised and well organized. The teacher should be aware of any possible medical problems prior to the start of a field exercise - allergies, asthmatic children, etc.
4. Students should be instructed prior to field studies as to safety rules governing proper conduct in the out-of-doors, e.g., stay in a group, noise levels, leave nature intact, etc. Use a printed sheet of instructions.
5. Proper clothing is mandatory, e.g., shoes, guard against exposure, insect bites, plant contact, sun, frostbite, windchill, etc. See Appendix L, Wind Chill Chart, page 85.
6. A first aid kit is advisable for trips away from the school site. Check it for essential equipment.
7. Students should never eat or place in mouth any plant or plant part, or rub the sap onto skin unless instructed and supervised by the teacher. (e.g. edible plant study).
8. Pond or stagnant water should never enter the mouth. Students with scratches or open wounds should not go near pond or stagnant water.
9. Littering should be discouraged, the teacher can do much in this area by setting the example.
10. If used, fires must be supervised at all times. A fire pit and clearance of surrounding trees, shrubs, grasses is necessary.
11. Students should be able to identify poison ivy, poison sumac, and poison oak prior to their field experience.
12. Paper, cloth, plastic bags, or plastic vials are recommended for collecting as glass containers are easily broken.
13. The buddy system may prove helpful.
14. Repellents should be administered to guard against insect bites. However, care must be taken to insure that no student is allergic to the repellents being used.
15. Most accidents which occur on field trips result from carelessness or horseplay by the students. Strict supervision will help eliminate this problem.

16. On many field trips, students will come across pollen grains to which they might be allergic and they probably should be excused from such experiences.

XI. HIGH RISK EXPERIMENTS

REFERENCE PAGE FOR HIGH RISK EXPERIMENTS

By their very nature some experiments present a higher risk than others. They include using:

	Page
Radioisotopes	47
Pathogens	47
Carcinogenic Agents	47
Dangerous Chemical Combinations	47
Formaldehyde	48
Gases	48
Pesticides	48
Mercury	48
Electricity	48
Blood Experiments	48
Chlorophyll	48
Cheek Cells	48
Hypodermic Needles	48
Animals	48

XI. HIGH RISK EXPERIMENTS

A. INTRODUCTION

Many classroom activities are considered dangerous and the teacher should be well aware of them. There is always risk but the following are a few of the high risk experiments to which the teacher should pay particular attention.

B. STATEMENT OF HAZARDS

The teacher should have previous knowledge of each experiment and should be aware of its possible consequences. Precaution is the prime factor. Most high risk situations should be demonstrations; performed by the teacher. Follow the school policies.

C. RADIOISOTOPES IN BIOLOGY

The use of all radioactive materials and other sources of ionizing radiation will be in compliance with the Federal Register, Title 10, Chapter I, Par. 20.104, "Exposure of Minors".

Registration for all sources of Ionizing Radiation, Act 88, P.A. 1943, Michigan Department of Public Health (3500 N. Logan Street, Lansing, Michigan), requires the registration of all sources of ionizing radiation, regardless of level. This would include radioactive isotopes and materials, X-ray machines, and cathode ray tubes (i.e. black lights, shadow tubes, etc.). Anytime high voltage leads to high speed particles being produced, registration may be necessary.

Follow the school policy on radioisotopes.

General radiation safety regulations should be given to each student who will be working with radioactive materials; they also should be posted conspicuously in the laboratory. See the Appendix M, Lab Activities with Radiation, page 87, for radiation safety regulations from Science Advisory Committee.

D. PATHOGENS - See Chapter II, Microbes, page 8.

E. CARCINOGENIC AGENTS - See Chapter IV, D, page 38.

F. DANGEROUS CHEMICAL COMBINATIONS - See Chapter IX, E, page 39.

G. USE OF CHEMICALS

Formaldehyde - see Chapter IX, G #20, page 41 .
Gases - from ethers, alcohol, etc., should be used in a hooded area. Many are poisonous.
Pesticides - see Chapter III, H, page 14 .
Mercury - may be absorbed through the skin. It also vaporizes slowly. It is a cellular poison.

H. ELECTRICITY - do not use high voltages or faulty equipment.

I. BLOOD EXPERIMENT - see Chapter V, C, page 24 .

J. EXTRACTION OF CHLOROPHYLL

1. Only pyrex glass tubes should be used.
2. Use a water bath heated by electric hot plate for heating the alcohol.

K. CHEEK CELLS

When removing epithelial cheek tissue for examination under a microscope: students should be precautioned about gouging the cheek tissue. Toothpicks or sterile cotton swabs used to collect cells should be disposed of in special containers immediately after use.

L. HYPODERMIC NEEDLES

Hypodermic needles should be kept in a locked area, record should be kept of usage. When finished with use they should be destroyed primarily by incineration.

M. USE OF ANIMALS - see Appendix G, Diseases of Animals/Man, page 71.
For bites, see Chapter XIII, F, page 54 .

XII. SPECIAL ACTIVITIES

REFERENCE PAGE FOR SPECIAL ACTIVITIES

Give a safety check for all projects.

Do not use cyanides, corrosive chemicals, highly flammable fluids, pathogens, hypodermic needles, open flames, explosives, poisonous snakes. See Statement of hazards, page 50 .

XII. SPECIAL ACTIVITIES

A. INTRODUCTION

Projects prepared by students should definitely be given a thorough safety check.

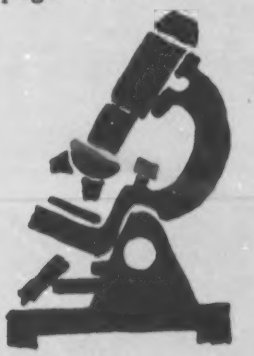
Teachers should not only question students concerning the safety precautions taken in a project, and their understandings relative to the specific hazards and precautions necessary for them, but should also personally check the projects or request some other knowledgeable person to do so.

B. STATEMENT OF HAZARDS

Science fair rules often ban the use of strong reagents, open flames, explosives and materials liable to spontaneous combustion, dangerous gases, poisons, pathogenic organisms and other troublesome materials or activities. Teachers should be familiar with and acquaint students with the rules governing any science fair, exhibit or contest for which projects may be developed.

C. PRECAUTIONARY MEASURES

1. Any project which will be viewed by the public should be constructed so that "inquisitive observers" are protected from possible accidents as well as those who merely look. Provisions such as these will also help to cut down or eliminate careless handling by the occasional souvenir hunter.
2. No dangerous or flammable chemicals should be used in an exhibit.
3. No live poisonous snake should be permitted in exhibits under any circumstances.
4. All electrical apparatus must be constructed according to standard electrical safety laws. If in doubt, consult a competent electrician.
5. The use of radioactive materials and other sources of ionizing radiation will be in compliance with the Federal Register, Title 10, Chapter 1, Paragraph 20.104, "Exposure of Minors".
6. Animal Use - see Chapter IV on Use of Animals. Also see Appendix F, Certification (Animal Use), page 69.



XIII. EMERGENCIES

REFERENCE PAGE FOR EMERGENCIES

Make a list of emergency phone numbers. For some necessary numbers see Emergency Phone Numbers, page 52 .

In case of fire, see page 52 .

Fire extinguishers, see page 53 .

First aid checklist, see page 54 .

Poison Control Center telephone numbers, page 56 .

XIII. EMERGENCIES

A. INTRODUCTION

Emergencies can occur frequently in high school laboratory settings. Knowledge of how to deal with them is of paramount importance. It is a teacher's responsibility to provide for the safety and protection of the students in the classroom or laboratory. The teacher must know how to react and proceed when faced with emergency situations or injury. The teacher must care for students in accordance with the laws or rules of his particular school district. He must, therefore, familiarize himself with his rights, liabilities and responsibilities when in an emergency situation. This is of prime importance as it can be critical to the well-being of the student.

Only a few situations can be covered here. Other references to safety situations occur throughout the course of this guide. Many are covered in the first aid check list.

B. STATEMENT OF HAZARDS

BE PREPARED! Follow the established school procedure for emergency situations. If there are none, get some established. If you don't know them, find out what they are.

C. EMERGENCY PHONE NUMBERS - Keep these phone numbers handy.

Rescue squad
Fire
Police
Health department
Poison control (local)
State Science Supervisor: (804) 786-2672
Local hospital

D. IN CASE OF FIRE

1. Don't panic.
2. Don't allow students to run.
3. Call for help.
4. Handle injured person as little as possible.
5. Be cautious rather than casual.
6. Be calm and deliberate.
7. Hair on fire!! Smother with blanket or jacket or roll on floor. NEVER use CO_2.
8. Clothing on fire!! Smother with blanket or jacket or roll on floor. NEVER use CO_2.
9. The danger in personal fires is that the affected student will seek his own aid and in a state of panic run about fanning the flames, thus magnifying the danger to himself.
10. The teacher must quickly determine the immediate and potential danger from the fire. If the fire presents a serious threat, then sound the fire alarm.
11. In the event of minor skin burns, do not apply grease or oil. See First Aid - Burns, next section of this chapter.

KNOW YOUR
FIRE EXTINGUISHERS

WATER TYPE

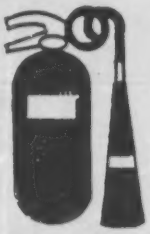
A

Ordinary Combustible Fires

DRY CHEMICAL

B

Flammable Liquid Fires
(Gas and Grease)



CO^2 TYPE
(Plastic Horn Only)

C

Electrical Equipment Fires

MULTI-PURPOSE DRY CHEMICAL TYPE

A
B C

For Ordinary Combustible Fires
Flammable Liquid Fires
Electrical Equipment Fires

DRY POWDER TYPE

D

For Combustible Metal Fires
(These Metals In Finely Divided Form Need Special Fire Attack)

USE ONLY UNDERWRITERS APPROVED EXTINGUISHERS

F. FIRST AID CHECK LIST

The teacher may be confronted with situations in which the administration of first aid is necessary. It is important to remember that as a teacher you are not a trained nurse or doctor, but you should familiarize yourself with basic steps. In an emergency situation, first aid procedures must be strictly followed to avoid further complications. Medical help must be summoned immediately. In the schools, local regulations must be observed.

The following procedures are ones which may occur in the school. Many were taken from "First Aid and Emergency Procedures in Schools," Michigan Department of Health, Michigan Department of Education.

Allergies

There are a wide variety of substances which can cause an allergic reaction. A good precaution is to become aware of students with known allergies. Insect bites may cause acute reactions - they may be fatal.

- -Check with school policy or know school policy.
- -Check for symptoms - hives, rash, pallor, nausea, tightness in chest or throat, trouble speaking or breathing.
- -If possible, question the student to find out cause and possible treatment.
- -Treat for shock if needed.
- -Seek medical attention if needed. Do not attempt to provide more treatment than absolutely necessary.

Animal Bites

Minor skin abrasions and superficial lacerations

- -Wash thoroughly with soap and water.
- -Do not use iodine or other antiseptic.
- -Bandage.

Major bites, puncture wounds

- -Wash wound with soap and water.
- -See a physician.
- -Isolate animal and hold for 10 days.
- -Report all animal bites.

Bee Stings

- -Apply cold compress.
- -If possible remove stinger.
- -Be alert for symptoms of allergic reaction.

Artificial Respiration - Mouth-to-mouth is most effective and fastest.

- -Clean mouth of foreign matter and tilt victim's head back so chin is pointing up.
- -Place your mouth over victim's mouth and pinch victim's nostrils or close with your cheek and blow vigorously (adults about 12 per minute, child about 20 per minute). Continue until victim regains consciousness.
- -Treat for shock.
- -Seek medical attention at once.

Bleeding

For severe bleeding

- -Apply direct pressure to the wound with bandage.
- -Do not remove cloth when blood soaked - just add others on top and continue pressure till bleeding stops.
- -Elevate bleeding part above heart.
- -If bleeding continues - apply pressure to arterial pressure points.
- -Do not use tourniquet.
- -Do not use iodine.
- -Seek medical assistance.

Blisters

- -Wash with soap and water.
- -Open blister with sterile needle: gently press out fluid.
- -Bandage with sterile gauze.
- -Watch for infection.

Bruises

- -Apply cold compresses for relief of pain.

Burns

A. Minor (unbroken skin)

- -Apply cold water immediately and continue for 30 minutes - not ice water- or apply cold compress for 1 or 2 hours.
- -Do not use antiseptics, ointment or home remedies.
- -Consult a physician, if needed.

B. Major (broken skin)

- -Cover burn with 5 layers of sterile dressing.
- -Prevent air and bacteria from contacting burned area.
- -Treat for shock.
- -Do not remove clothing stuck to burn.
- -Do not apply ice.
- -Get medical aid quickly.

Chemical Burns

- -Flush away chemical with water for 5 minutes.
- -Apply first aid.
- -Get medical help.

Chemical Eye Burns

- -Immediately flush eye with large amount of water - use eye shower.
- -Hold eyelids open with fingers.
- -After thoroughly washing cover eye with dry sterile dressing.
- -Do not use oil or ointment.
- -Seek medical help at once.

Chemical Poisoning

- -Call Poison Control Center (next page). Follow their instructions.

-Try to identify what was swallowed.
-If known antidote is available follow instructions for use.
-Do not give anything orally if person is not awake.
-Get medical help.

Poison Control Centers

Ann Arbor	Poison Control Center University of Michigan Medical Center
764-5102	48104
Detroit	Poison Control Center Children's Hospital
494-5711	3901 Beaubien 48202
	Poison Information Center City Health Department
TR 2-1540	1151 Taylor Avenue 48202
	Poison Control Center Mount Carmel Mercy Hospital
864-5400	6071 West Outer Drive 48235
Flint	Poison Control Center Hurley Hospital
CE 2-1161	6th Avenue & Begole 48502
Monroe	Poison Control Center Memorial Hospital of Monroe
CH 1-6500	700 Steward Road 48161
Pontiac	Poison Control Center St. Joseph Mercy Hospital
858-3000	900 Woodward Avenue 48053
Port Huron	Poison Control Center Mercy Hospital
Yukon 5-9531	2601 Electric Avenue 48060

Cuts (minor wounds)

-Wash with soap and water and rinse thoroughly with clean running water.
-Apply sterile dressing.
-Do not use antiseptic unless recommended by a physician.

If severe cut or wound

-Use first aid for bleeding.
-Treat for shock.
-Get medical aid at once.

Electrical Shock

-Turn off current, free victim from contact.
-Keep victim warm.
-Begin mouth-to-mouth breathing if breathing has stopped. (may also need external cardiac compression).
-Get medical help.

Eye - small objects in eye

-Do not use dry cotton on the eye.
-Pull down lower lid - if object can be seen remove with moist cotton swab, tissue, or corner of handkerchief.
-Do not rub eye.
-Flush eye with water after removal of small object or if unable to be seen.

Fainting

-Prevented by lying down on back with feet up or sitting and bending head between knees. Remain at rest for 10 minutes.
-Fainting for no reason - see a physician.

Fractures

-Do not move victim unless necessary, especially suspected back, neck, or hip injuries.
-Splint breaks of arms or legs.
-Get medical aid.

Frostbite

-Do not rub with snow.
-Get by immersing in warm water ($100^{\circ}F$).
-Do not use hot nor cold water.
-Handle frosted members with great care.

Gas Inhalation

-Get victim to fresh air quickly.
-Call for medical help. Advise that oxygen should be brought.
-Loosen clothing, wrap victim in blanket.
-Start mouth-to-mouth breathing and external cardiac compression if necessary.

Heat Exaustion and Heat Stroke

-Remove person to cool surroundings.
-Cool body temperature if high (104° - 106°F).
-Raise feet and legs.
-Loosen clothing and apply cold cloths.
-Give sip of salt water (1 teaspoon to 1 glass of water). Stop if victim vomits.
-Get medical aid.

Insect Bites

-Be alert for allergic reactions and follow procedure for allergic reactions or
-Apply cold compresses, or soothing ointment.

Poison Ivy, Oak or Sumac

-Wash affected area with alkali-base soap (Laundry soap).
-Have remedy available.
-See doctor.

Plant Poisoning

-Induce vomiting immediately.
-Call Poison Control Center.
-Take victim for medical aid.

Shock

-Get immediate medical aid.
-Loosen clothes, cover victim with coat or blanket - do not apply heat.
-Lie on back with feet raised.
-Do not give fluids.
-Give mouth-to-mouth breathing and cardiac compression if necessary.

Snakebite

A. Nonpoisonous

-Wash bite with soap and water.
-Apply sterile bandage.
-See a doctor.

B. Poisonous

-Kill snake for identification if possible.
-Keep victim quiet.
-Immobilize bitten area. Keep it lower than heart.
-Call for antivenom availability.
-Get medical treatment as soon as possible.
-Do not give alcohol in any form. If treatment is delayed and snakebite kit is available, use as directed.

Snowblindness

-Apply cool, wet compresses to the eyes.
-Victim should wear dark sunglasses.
-Aspirin may relieve pain.
-Seek medical help.

Spider Bites

-Apply cold compress to bite.
-Get medical aid quickly.

Sunburn

-For mild cases use aspirin.
-Blister burns need medical attention.

G. References

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Lewis, Maxine, A-to-Z Summer First Aid Guide, Family Circle Magazine, July 26, 1977

Safety in the Science Laboratory, State Department of Education, Tallahassee, Florida, Bulletin 74, 1968.

XIV. SOME RECOMMENDATIONS

XIV. SOME RECOMMENDATIONS

A. INTRODUCTION

The following are merely suggestions that may help you create a more safe classroom or laboratory situation.

B. RECOMMENDATIONS

1. Attempt to set up a district-wide safety procedure. Start by making the administration sensitive to safety. Use your own room as an example so other members of the science department can have a prototype.
2. Make provisions for some form of training or education within your own department (e.g. workshop, in-service).
3. Set up a procedure for emergencies such as fire, first aid, etc. Put it on the bulletin board and inform the students. Doing a practice session (dry run) may be extremely helpful in preventing serious injury and showing concern in fulfilling teacher responsibility.
4. The teacher should do a safety check on the safety and regular equipment and facilities in their own laboratory or classroom. See samples in Appendices N and O, page 88 and 90.
5. Set up a proper waste disposal system for agents that may be harmful (microbes, glassware, caustic chemicals, etc.).
6. Laboratory safety rules should be posted, discussed, and the student should receive a copy. See sample Appendix P, page 91 .
7. The student, the parent, and the teacher should sign a copy of a safety agreement. See sample in Appendix Q page 92 .
8. The teacher should demonstrate special techniques prior to use in a laboratory setting.
9. A pre-warning of hazardous situations should be a part of any laboratory lesson plan.
10. Stop any lesson or activity if you judge that it is becoming unsafe.
11. Place eye catchy or alert signs in places or at times of risk.
12. Report in writing all faulty equipment in need of repair.
13. Be informed of and follow all established rules and procedures of your school.
14. Write to University of Michigan
    Dr. William Joy
    Department of Occupational Safety and Environmental Health
    Ann Arbor, Michigan
    To be included on the mailing list for the laboratory safety newsletter.

APPENDICES

Appendix A

LIABILITY AND TEACHERS

In order for you to be aware of the legal implications that are associated with teaching you should be familiar with the following:

a. Sovereign immunity
b. Criminal negligence
c. Tort laws

In the past in many states the schools were considered to be a subordinate unit of the state government and as such were protected from suits in cases of bodily injury which resulted from the negligence of an employee under what was known as Sovereign Immunity. Simply stated it meant that you couldn't sue the King or the state. Some teachers who have heard of sovereign immunity have had the mistaken idea that they were also protected from suit, this is not the case. In fact in recent years in Michigan school boards and board members have found that the idea of sovereign immunity is no longer accepted by the courts. School boards and teacher associations now carry insurance to provide some protection for their employees.

Criminal negligence involves committing a crime against society which may involve injury or death to another individual. In a case of criminal negligence the individual is already committing a crime when the injury or death occurs which in itself would subject him to arrest, trial, and imprisonment. An example might be a teacher driving a school bus full of students on a field trip while under the influence of alcohol or drugs.

In a school accident a teacher may not be charged under criminal negligence and yet be taken to court in a tort lawsuit. Whereas in criminal negligence a crime is committed against society; in committing a tort one may break the law against an individual. A tort is defined as a civil wrong committed against another person. There are four elements which must be shown if a person is to be held liable in a tort lawsuit. They are:

1. "Duty" All people owe all other people the duty of not infringing their right to be free from physical and mental injury. As a teacher you then should know what your duty is in relation to your students.

2. "Violation or Breach of Duty" When an individual has infringed another's rights he has violated or cimmitted a breach of duty.

3. "Cause or Proximate Cause" If a student is injured and the injury might have been prevented by you the teacher performing your job in a reasonable manner, then you could be the "proximate cause" for that injury.

4. "Injury" In the case of a student, the infringement of the individual's rights by you as the teacher results in the student being injured either physically or mentally.

One key factor in such suits is the idea of reasonableness. If the teacher acts in a manner that could be expected by any other teacher in a similar situation then he is not guilty of a tort violation.

Gatti offers these guide rules for teachers in considering liability and teacher responsibilities under the law:

GUIDE RULE: BEING A TEACHER MAKES YOU RESPONSIBLE FOR YOUR STUDENTS' INSTRUCTION, SUPERVISION AND SAFETY. IF YOU DO NOT FULFILL THIS RESPONSIBILITY, YOU MAY BE HELD LIABLE.[1]

You can be held liable for anything that you have done which is improper or wrong. The key to your actions is "reasonableness". Gatti in describing negligence explains it in terms of reasonableness as follows:

> Negligence is: not doing something which the reasonable teacher, considering the circumstances, would ordinarily do; or doing something which the ordinary teacher of reason and prudence would not do.[2]

He further offers these rules concerning negligence and reasonableness:

GUIDE RULE: NEGLIGENCE EXISTS WHERE THE ACTIVITY OR CONDUCT ON THE PART OF THE TEACHER CREATES AN UNREASONABLE CHANCE OF DANGER. WHEN THE TEACHER IGNORES THE DANGER, OR DOES NOT SEE THE DANGER WHEN HE SHOULD, HE MAY BE HELD NEGLIGENT IF SOMEONE IS INJURED AS A RESULT.[3]

GUIDE RULE: DID THE ACT WHICH CAUSED THE INJURY EXCEED REASONABLE LIMITS, TO THE POINT WHERE THE TEACHER WAS NOT ACTING WITHIN THE RIGHTS OF HIS EMPLOYMENT? IF SO, HE IS RESPONSIBLE.[4]

Gatti also states that a teacher should not only have safety rules for the students to follow in the class but the teacher should also see that the rules are enforced.

GUIDE RULE: IF A RULE IS BROKEN, STEPS MUST BE TAKEN TO ASSURE THAT THE INFRACTION WILL NOT OCCUR A SECOND TIME. IF A TEACHER DOES NOT TAKE FURTHER STEPS, HE MIGHT BE FOUND LIABLE ON THE GROUNDS THAT THE RULE DID NOT REALLY EXIST, EXCEPT ON PAPER.[5]

Along with reasonableness the idea of forseeability is important in determining if a teacher has acted in a responsible manner. Gatti offers the following rule on forseeability:

GUIDE RULE: INJURY IS GENERALLY FORSEEABLE IN SITUATIONS (1) WHERE LARGE CROWDS OF STUDENTS ARE GATHERED WITHOUT SUPERVISION; (2) IN SPECIALIZED ACTIVITIES IN VOCATIONAL EDUCATION, PHYSICAL EDUCATION AND SCIENCE CLASSES; OR (3) IN CASES WHERE YOU ARE ABSENT FROM THE ROOM FOR AN UNREASONABLE AMOUNT OF TIME.[6]

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[1] Gatti, Daniel Jon. The Teacher and the Law. West Nyack, New York. Parker Publishing Company, Inc. 1972. Page 19.
[2] Ibid. Page 52.
[3] Ibid. Page 52.
[4] Ibid. Page 22.
[5] Ibid. Page 57.
[6] Ibid. Page 62.

Appendix B

MICHIGAN OCCUPATIONAL SAFETY & HEALTH

Act 154 of P.A. 1974

Department's Authority

Make inspections of work places based upon employee complaints concerning alleged hazardous working conditions.

Conduct unscheduled inspections at reasonable times and in a reasonable manner of all places of employment in order to physically inspect work areas for compliance with safety standards.

Advise an employer that an imminent danger exists and issue administrative orders requiring that steps be taken which are necessary to avoid, correct, or remove the imminent danger.

Issue citations and proposed penalties to any employer for failure to comply with standards, rules, orders or provisions of this Act.

Issue cease operations orders when an employer fails to comply with a final order of the Board.

Employer's Responsibilities

Furnish and maintain a work environment which is free from recognized hazards that are causing or likely to cause death or serious physical harm.

Comply with specific Occupational Safety and Health Standards that apply to working conditions in their establishments.

Post notices and use other required or appropriate means of informing employees of their protections and obligations under the Act.

Post all citation appeal decisions in the same manner as citations so as to inform employees.

Employee's Responsibilities

Comply with all applicable Occupational Safety and Health Standards established under the Act.

Refrain from removing, displacing, damaging, destroying, or carrying off a safeguard furnished or provided for use in a place of employment or interfering in any way with the use thereof by any other person.

Employee's Rights

Entitled to work in a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm.

May file a written request with the Department for an inspection where it is believed that a violation of a standard exists. Entitled to have identity withheld and to receive a written reply of Department findings.

May request an immediate inspection when an alleged imminent danger exists.

Authorized employee representative is entitled to accompany the Department representative during an inspection or investigation.

Authorized employee representative is entitled to a conference with the departmental representative to review findings upon completion of an inspection or investigation.

Entitled to know that a citation was issued by the Department through the posting of such citation near the place of violation.

Entitled to receive medical tests or examinations when required by a standard.

Entitled to be apprised by employer of a health hazard to which he or she is exposed when the hazard is covered by a standard.

Entitled to protection against being discharged or otherwise discriminated against for filing a complaint or instituting a proceeding under this Act.

NOTE: Where employees select a person to represent them, employee rights may be exercised by the "authorized employee representative" as provided in the Act.

For further information contact:

Michigan Department of Labor
Bureau of Safety & Regulation
7150 Harris Drive
Lansing, MI 48926
General Industry Division (517) 37-39620
Construction Safety Division (517) 37-39634
Safety Education & Training (517) 37-39160

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Appendix C

HANDICAPPED STUDENTS

Some special precautions should be taken for the safety of handicapped students. The following are some guidelines.

1. The work area should be low enough to allow a student in a wheelchair to work safely. It should be constructed so that spills onto the student are prevented.

2. Whenever possible, ramps, as well as, stairways, should be provided for students in wheelchairs.

3. Students in wheelchairs should be assigned work areas near exits and non-handicapped laboratory partners.

4. Students who have hearing or vision handicaps should be assigned responsible laboratory partners who are without handicaps.

5. Students who have unusual emotional, or behavioral problems should be identified at the start of the semester and be carefully monitored when using dangerous, or expensive equipment. They should be removed from the classroom when their behavior could cause a hazard to themselves or other students.

Appendix D

FEDERAL AND STATE LAWS

1. Rocket and Missile Launching, Federal Aviation Regulation Part 101. Governs the size, type, construction, and launching considerations of model rockets. Minimum size rockets that would fall under control of this regulation would be illegal in Michigan, as they would exceed maximum allowable specification under Michigan's Model Rocket Law.

2. Michigan Model Rocket Law, Act. 333, P.A. 1965, Michigan Statutes Annotated of 1965 (18,1236).
Specifies the size, type, construction, testing, and launching requirements for model rockets.

3. Registration of labs Handling Pathogenic Micro Organisms, Act. 308, P.A. 1927, Michigan Department of Public Health, 3500 N. Logan Street, Lansing, Michigan. Requires the registration of all laboratory facilities utilizing pathogenic microorganisms.

4. Registration of Labs for the Human use of Animals, Act. 241, P.A. 1947, Michigan Department of Public Health, 3500 N. Logan Street, Lansing, Michigan. Requires the registration of each individual laboratory facility utilizing animals for experimental purposes. It should be noted that keeping animals for the purpose of observing their natural growth and development would not require registration.

   340.365-As part of the curriculum, every public school teacher in Michigan shall teach kindness and justice to, and humane treatment and protection of animals and birds.

5. Registration for all sources of Ionizing Radiation, Act. 88, P.A. 1943, Michigan Department of Public Health, 3500 N. Logan Street, Lansing, Michigan. Requires the registration of all sources of ionizing radiation, regardless of level. This would include radioactive isotopes and materials, X-ray machines, and cathode ray tubes (i.e. black lights, shadow tubes, etc.) Any time high voltages lead to high speed particles being produced, registration may be necessary.

6. School Fire Safety Regulations, Act. 207, P.A. 1941, Fire Marshal Division, Michigan State Police, 416 Frandor Avenue, Lansing, Michigan. Governs the design, construction, and operation of school facilities with respect to fire safety. Chemical storage requirements are a part of this act.

7. Occupational Safety, Act. 282, P.A. 1967, Michigan Department of Labor, 300 E. Michigan Avenue, Lansing, Michigan. Mandatory safety standards are promulgated under this act that affect all areas of the school facility. Standards requiring the guarding of power transmission equipment, floor and wall openings and stairways, and eye and face protection are but a few. Complete sets of current standards may be obtained from the Occupational Safety Standards Commission, Michigan Department of Labor.

8. Act No. 54 of the Public Acts of 1972 Requires students, teachers and visitors to wear industrial quality eye protective devices when exposure to danger exists. Eye protective devices must be sanitized prior to use. The law lists a wide variety of potentially dangerous situations in which glasses should be worn.

Appendix E

GUIDING PRINCIPLES FOR USE OF ANIMALS IN ELEMENTARY AND SECONDARY SCHOOLS

1. In biological procedures involving living organisms, species such as plants, bacteria, fungi, protozoa, worms, snails, or insects should be used wherever possible. Their wide variety and ready availability in large number, the simplicity of their maintenance and subsequent disposal makes them especially suitable for student work. In mammalian studies, non-hazardous human experiments are often educationally preferable to the use of species such as gerbils, guinea pigs or mice.
2. No procedure shall be performed on any warm-blooded animal that might cause it pain, suffering, or discomfort or otherwise interfere with its normal health. Warm-blooded animals include man, other mammals such as gerbils, guinea pigs, mice, rabbits, hamsters and rats. It also includes birds, such as hens, quail, and pigeons. This means that a student shall do unto other warm-blooded animals only what he can do to himself without pain or hazard to health.
3. No surgery shall be performed on any living vertebrate animal (mammal, bird, reptile or amphibian.)
4. No lesson or experiment shall be performed on a vertebrate animal that employs microorganisms which can cause disease in man or animal, ionising radiation, cancer producing agents, chemicals at toxic levels, drugs producing pain or deformity, extremes of temperatures, electric or other shock, excessive noise, noxious fumes, exercise to exhaustion, overcrowding or other distressing stimuli.
5. Animal observations must be directly supervised by a competent science teacher who shall approve the plan before the student starts work. Students must have the necessary comprehension and qualifications for the work contemplated. The supervisor shall oversee all experimental procedures, shall be responsible for their non-hazardous nature and shall, personally, inspect experimental animals during the course of the study, to ensure that their health and comfort is fully sustained.
6. Vertebrate studies shall be conducted only in locations where proper supervision is available: either in a school or an institution of research or higher education. No vertebrate animal studies shall be conducted at a home (other than observations of normal behavior of pet animals such as dogs or cats).
7. In vertebrate studies, palatable food shall be provided in sufficient quantity to maintain normal growth. Diets deficient in essential foods are prohibited. Food shall not be withdrawn for periods longer than 12 hours. Clean drinking water shall be available at all times (and shall not be replaced by alcohol or drugs).
8. Birds' eggs subjected to experimental manipulations shall not be allowed to hatch; such embryos shall be killed humanely no later than the nineteenth day of incubation. If normal egg embryos are to be hatched, satisfactory arrangements must be made for the humane disposal of chicks.
9. In the rare instances when killing of a vertebrate animal is deemed necessary, it shall be performed in an approved humane (rapid and painless) manner by an adult experienced in these techniques.
10. Projects involving vertebrate animals will normally be restricted to measuring and studying normal physiological functions such as normal growth, activity cycles, metabolism, blood circulation, learning processes, normal behavior, reproduction, communication or isolated organ techniques. None of these studies requires infliction of pain.
11. The comfort of the animal observed shall receive first consideration. The animal shall be housed in appropriate spacious, comfortable sanitary quarters. Adequate provision shall be made for its care at all times, including weekend and vacation periods. The animal shall be handled gently and humanely at all times.
12. Respect for life shall be accorded to all animals, creatures and organisms that are kept for educational purposes.

Approved by:

The Humane Society of the United States;

The Veterinary Advisory Committee
Robert C. Bay, D.V.M., Chairman

The Special Study Committee on the Use of
Animals in Biomedical Research and
Testing
Barbara Orlans, Ph.D., Coordinator

Note: Educators and students may obtain a free listing of recommended study projects and/or project books for pre-university levels by writing to one of the following sources:

The Animal Welfare Institute
Post Office Box 3650
Washington, D.C. 20007

The Humane Society of the United States
1604 K Street
Washington, D.C. 20006

Canadian Council on Animal Care
151 Slater Street
Ottawa, KIP 5H3, Ontario
Canada

Appendix F

CERTIFICATION

1. For approval to start and
2. To show that direct supervision has been provided throughout the course of the biological observations involving living non-human vertebrate animals.

Student's Name: _____
(First) (Middle Initial) (Last Name)

Grade: _____

School: _____

Address of School: _____

Species of Animals: _____ (Number) _____

Source of Animals: _____

Location where animals kept during study: _____

Title of Experiment: _____

Purpose of Study: _____

_____

Describe, precisely, the experimental procedures which will involve living vertebrate animals:

_____

_____

1. This is to certify that the above named student has planned and prepared his/her project which fully complies with these "GUIDING PRINCIPLES FOR USE OF ANIMALS IN ELEMENTARY AND SECONDARY SCHOOLS", (shown overleaf), and that permission to start this project was granted on:

_____ Signed: _____
date (Teacher)

Signed: _____
(Science Department Chairman)

2. This is to certify that the aboved named student has been directly supervised throughout the course of the now completed study and that no vertebrate animal has been subjected to surgery, pain, interference with normal health or lingering death.

_____ Signed: _____
date (Supervising Teacher)

Write for free extra copies to:
The Humane Society for the United States 1604 K Street, N.W., Washington, D.C. 20006

Appendix G

DISEASE OF ANIMALS/MAN

The following list was provided for inclusion by the Safety Education and Training Division, Bureau of Safety and Regulation, Michigan Department of Labor, Michigan Department of Public Health.

Important Viral Diseases in Man and Other Animals; the Animals are listed in order of susceptibility to each diseases.

Appendix G

DISEASE OF ANIMALS/MAN

The following list was provided for inclusion by the Safety Education and Training Division, Bureau of Safety and Regulation, Michigan Department of Labor, Michigan Department of Public Health.

Important Viral Diseases in Man and Other Animals; the Animals are listed in order of susceptibility to each diseases.

DISEASE	ANIMALS SUSCEPTIBLE	ORGANS AFFECTED	CHARACTERISTICS
Rabies	Man, dogs, lab. animals, carnivores, herbivores, bats.	Brain, spinal cord, salivary glands.	Neurotropic.
Pseudorabies	Cattle, guinea pigs, mice, man, monkeys, rabbits, pigs.	Brain, spinal cord, spinal ganglia, heart.	Neurotropic.
Variola (smallpox)	Man, monkeys, sheep, rabbits.	Skin, lungs.	Dermotropic, epitheliotropic.
Cowpox	Cattle, man, sheep, guinea pigs, rabbits.	Skin.	Dermotropic.
Sheeppox	Sheep, man, horses, goats.	Skin.	Dermotropic.
Fowlpox	Birds, mice.	Skin, mouth, nasal sinuses, crop, esophagus.	Dermotropic, epitheliotropic.
Ectromelia (mousepox)	Mice.	Feet, mouth, tail, liver, spleen, pancreas.	Dermotropic, epitheliotropic.

DISEASE	ANIMALS SUSCEPTIBLE	ORGANS AFFECTED	CHARACTERISTICS
Rubeola (measles)	Man, monkeys.	Skin, respiratory tract.	Dermotropic, epitheliotropic.
Varicella (chickenpox)	Man, monkeys, rabbits.	Skin, testicles, cornea.	Dermotropic, epitheliotropic.
Herpes simplex	Man, monkeys, guinea pigs, rabbits, mice.	Skin, cornea, mouth, tonsils, brain.	Dermotropic, neurotropic.
Herpes zoster	Man, monkeys, rabbits.	Skin, brain, cornea, spinal ganglia.	Dermotropic, neurotropic.
Sabine B virus	Monkeys, man, rabbits, hamsters.	Brain, meninges, skin, spleen, adrenal glands, lymph nodes.	Neurotropic, epitheliotropic, dermotropic.
Giant cell pneumonia	Man, monkeys.	Lungs.	Epitheliotropic.
Yellow fever	Man, monkeys, mice, marsupials.	Kidneys, liver.	Epitheliotropic.
Infectious hepatitis	Man.	Liver.	Epitheliotropic.
Rift Valley fever	Sheep, cattle, man, mice, ferrets, hamsters, rats (European, African rodents).	Liver, gallbladder, lymph nodes.	Epitheliotropic, endotheliotropic
Louping ill	Sheep, man, mice, monkeys, pigs.	Brain, spinal cord.	Neurotropic.
Bluetongue	Sheep, cattle, goats, mice.	Lips, tongue, gums, nose, muscles, coronary band.	Endotheliotropic, epitheliotropic.
Distemper	Dogs, foxes, ferrets, racoons, mink, skunks.	Brain, urinary tract, gallbladder, lungs spleen, lymph nodes, stomach.	Neurotropic, epitheliotropic.
Canine hepatitis	Dogs, foxes.	Kidneys, liver, gallbladder, spleen, bone marrow, brain, testicles.	Epitheliotropic, mesotheliotropic, neurotropic.
Panleukopenia	Cats, lions, tigers, racoons.	Ilium, colon, spleen, mesentery, lymph nodes, bone marrow.	Epitheliotropic, mesotheliotropic.

DISEASE	ANIMALS SUSCEPTIBLE	ORGANS AFFECTED	CHARACTERISTICS
Feline pneumonitis	Cats, mice.	Nasal passages, conjunctiva, lungs.	Pneumotropic.
Infectious myxomatosis	Rabbits.	Skin, subcutaneous tissue, spleen, lymph nodes.	Epitheliotropic, mesotheliotropic.
Shope fibroma	Rabbits, squirrels.	Subcutaneous tissue.	Mesotheliotropic.
Virus III	Rabbits.	Testes, heart.	Endotheliotropic, cardiotropic.
Equine virus abortion (rhinopneumonitis)	Horses, hamsters.	Lungs, liver, bile duct, lymph nodes.	Epitheliotropic.
Vesicular stomatitis	Horses, cattle, pigs, guinea pigs.	Tongue, lips, gums.	Epitheliotropic.
Bovine malignant catarrh	Cattle, rabbits	Mouth, nose, eyes, trachea, lungs, lymph nodes, intestines, brain.	Pneumotropic, epitheliotropic, neurotropic.
Infectious bovine rhinotracheitis	Cattle.	Nasal passages, trachea, bronchi.	Pneumotropic.
Sporadic bovine encephalomyelitis	Cattle, guinea pigs.	Peritoneum, spinal cord, brain.	Mesotheliotropic, neurotropic.
Mucosal disease	Cattle.	Mouth, esophagus, gallbladder, kidneys, colon, lymph nodes.	Epitheliotropic, mesotheliotropic.
Foot-and-mouth disease	Cattle, man, sheep, guinea pigs, goats, reindeer, camels, rabbits, mice, birds, carnivora.	Skin, lips, tongue, palate, vulva, udder, teats, feet, conjunctiva, stomach.	Dermotropic, epitheliotropic, myotropic.
Rinderpest	Cattle, goats, rabbits.	Stomach, lymph nodes, mouth, esophagus, intestines, kidneys, urinary bladder.	Epitheliotropic, mesotheliotropic.

DISEASE	ANIMALS SUSCEPTIBLE	ORGANS AFFECTED	CHARACTERISTICS
Hog cholera	Pigs.	Blood vessels, skin, colon, lymph nodes, urinary bladder, brain, meninges.	Endotheliotropic, neurotropic.
African swine fever	Pigs.	Blood vessels, skin, colon, lymph nodes, spleen, meninges, urinary bladder.	Endotheliotropic.
Teschen disease	Pigs.	Brain, spinal cord.	Neurotropic.
Vesicular exanthema	Pigs, horses.	Snout, lips, gums, tongue, feet.	Epitheliotropic.
Swine influenza	Pigs, ferrets, mice.	Trachea, lungs.	Pneumotropic.
Laryngo-tracheitis	Chickens, pheasants,	Larynx, trachea.	Epitheliotropic.
Newcastle disease	Chickens, turkeys, man, mice, hamsters.	Mouth, lungs, intestines, spleen, brain.	Epitheliotropic, neurotropic.
Owl disease	Owls.	Liver, spleen.	Epitheliotropic.
Wild rat nephritis	Wild rats.	Kidneys.	Epitheliotropic.
House myositis (Theiler's)	Mice.	Muscle.	Myotropic.
Mouse hepatoma	Mice.	Liver.	Epitheliotropic.
Salivary gland diseases	Man, chimpanzees, guinea pigs, rats, mice, dogs, hamsters.	Brain, lungs, liver, salivary glands, kidneys, adrenals, heart.	Epitheliotropic, neurotropic.
Lymphocytic chorio-meningitis	Mice, rats, man, monkeys, guinea pigs, dogs.	Meninges, brain, spinal cord.	Mesotheliotropic.
Encephalo-myelitis (Theiler's disease)	Mice.	Spinal cord, spinal ganglia, medulla.	Neurotropic.

DISEASE	ANIMALS SUSCEPTIBLE	ORGANS AFFECTED	CHARACTERISTICS
Dengue	Man, mice, monkeys.	Skin.	Dermatropic, neurotropic.
Polio-myelitis	Man, monkeys, mice, cotton rats.	Brain, spinal cord.	Neurotropic.
Western and eastern equine encephalitis	Horses, man, monkeys, guinea pigs, goats, cats, pigs, mice, hamsters, ducks, pheasants, turkeys.	Brain, spinal cord.	Neurotropic.
St. Louis encephalitis	Man, mice, monkeys.	Brain, spinal cord.	Neurotropic.
Japanese B encephalitis	Man, mice, guinea pigs.	Brain.	Neurotropic.
Venezuelan encephalitis	Horses, man, rabbits, guinea pigs, mice.	Brain, spinal cord, tongue.	Neurotropic, epitheliotropic.

Appendix H

INDIVIDUAL ANIMAL RECORD

SPECIES _____ LOCATION _____

SERIAL # _____ COLLAR # _____ SOURCE _____

DATE REC'D _____ SEX _____ AGE _____

WEIGHT _____ BODY LENGTH _____ TAIL LENGTH _____

HEIGHT AT SHOULDERS _____

BREED RESEMBLANCE _____

COAT COLORS _____ COAT TEXTURE _____

DISTINCTIVE MARKINGS _____

_____

_____

INITIAL PHYSICAL _____

_____

_____

DATE QUARANTINE COMPLETED _____

DATE ASSIGNED TO EXPERIMENT _____ INVESTIGATOR _____

(Attach all subsequent reports relating to physical exams, pathology, and therapy)

Adopted From: Manual For Laboratory Animal Technicians, Publication 67-3, American Association For Laboratory Animal Science, Joliet, Illinois, 1967.

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CAGE CARD FOR MOUSE BREEDING

D.M. 1/2/75			No. 199		RB SWISS				
1:1 (M17-11/21/74			F22 - 11/24/74)						
LIT B	# B	WEANED	# R	NOTES	LIT B	# B	WEANED	R	NOTES
1/23/75	11	2/12/75	11	1-S					
2/13/75	11	3/5/75	11						

D.M. = Date Mated

1-S = One to breeding stock

EXPERIMENTAL CAGE CARD

EXP. # A79

Room # 112

(Investigator)

Exp. Notes: 8RB Swiss born 8/15/75 Inov. IP c x 24 Et. .05 ml - .001 mg
SAVE ALL CARCASES

DATE 9/10/75

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1. -----Dead 9/11/75
2.
3.
4.
5.
6.
7.
8.

ANIMALS RECEIVED 9/26/75 TO _____

Requested By	Species	Strain	Sex	Spec	No. Ord.	Date Ord.	P.O. No.	Vendor	Carrier Info.	Shipping Costs	Cond. of ship.	Date Rec.	Instructions & Remarks
Teacher Name	Mouse	ABC	M	5-6 wks.	300	8/20	A75-68	Wee Furry Friends Inc.	Air Express #171-05-24 6 crates	7.60	O.K.	9/26	8 per PC Filter cage Quarantine Room 9255
	Black Snake	A-1	F	8 ft minimum	12	8/20	A77-77	Bar None Ranch Inc.	Pony Express	31.50	1 D. O.A. 11 O. K.	9/26	Open crates cautiously See office records

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Selection Chart

Recommended Eye and Face Protectors for Use in Industry, Schools, and Colleges

1. GOGGLES, Flexible Fitting, Regular Ventilation
2. GOGGLES, Flexible Fitting, Hooded Ventilation
3. GOGGLES, Cushioned Fitting, Rigid Body
*4. SPECTACLES, Metal Frame, with Sideshields
*5. SPECTACLES, Plastic Frame, with Sideshields
*6. SPECTACLES, Metal-Plastic Frame, with Sideshields
** 7. WELDING GOGGLES, Eyecup Type, Tinted Lenses (Illustrated)
7A. CHIPPING GOGGLES, Eyecup Type, Clear Safety Lenses (Not Illustrated)
** 8. WELDING GOGGLES, Coverspec Type Tinted Lenses (Illustrated)
8A. CHIPPING GOGGLES, Coverspec Type, Clear Safety Lenses (Not Illustrated)
** 9. WELDING GOGGLES, Coverspec Type, Tinted Plate Lens
10. FACE SHIELD (Available with Plastic or Mesh Window)
**11. WELDING HELMETS

*Non-sideshield spectacles are available for limited hazard use requiring only frontal protection.
**See appendix chart "Selection of Shade Numbers for Welding Filters."

APPLICATIONS		
OPERATION	HAZARDS	RECOMMENDED PROTECTORS: Bold Type Numbers Signify Preferred Protection
ACETYLENE–BURNING ACETYLENE–CUTTING ACETYLENE–WELDING	SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES	7, 8, 9
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	2, 10 (For severe exposure add 10 over 2)
CHIPPING	FLYING PARTICLES	1, 3, 4, 5, 6, 7A, 8A
ELECTRIC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	11 (11 in combination with 4, 5, 6, in tinted lenses, advisable)
FURNACE OPERATIONS	GLARE, HEAT, MOLTEN METAL	7, 8, 9 (For severe exposure add 10)
GRINDING–LIGHT	FLYING PARTICLES	1, 3, 4, 5, 6, 10
GRINDING–HEAVY	FLYING PARTICLES	1, 3, 7A, 8A (For severe exposure add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	2 (10 when in combination with 4, 5, 6)
MACHINING	FLYING PARTICLES	1, 3, 4, 5, 6, 10
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	7, 8 (10 in combination with 4, 5, 6, in tinted lenses)
SPOT WELDING	FLYING PARTICLES, SPARKS	1, 3, 4, 5, 6, 10
Foundryman's	Dust, Flying Particles	7 & 8 except it is padded

Appendix J

LABELING OF SOME COMMON CHEMICALS

The following chemicals have been commonly used in science experiments in the past. These are sample labels that might be used in identifying each.

1. Ammonium Dichromate
   Warning
   Flammable, harmful dust, may cause rash or skin ulcers.
   Keep away from heat, flames. Avoid contact with skin and eyes.
   Immediately flush area with water for 15 minutes for eyes, get medical attention. Wash clothing before reuse.

2. Ammonia-Aqua
   Warning
   Liquid causes burns. Vapor extremely irritating.
   Avoid vapor. Avoid contact with skin, eyes, and clothing.
   Immediately flush area with water for 15 minutes. Get medical attention for eyes.

3. Acetic Acid 28%-5-6 times more concentrated than vinegar
   Caution
   May cause burns.
   Avoid contact with skin, eyes, and clothing.
   Immediately flush with water. Get medical attention for eyes.

4. Boric Acid
   No harmful effects.

5. Bleach
   Caution
   Can be irritating to skin and eyes.
   Avoid contact with skin and eyes-wear protective clothing.
   Flush area.

6. Calcium Hydroxide (Garden Lime)
   No harmful toxic effects.
   Hands should be washed thoroughly after contact.
   If eyes are exposed or swallowed get medical help.

7. Carbon Tetrachloride
   Danger
   Hazardous vapor or liquid.
   May be fatal if inhaled or swallowed.
   Do not breath vapors. Use with adequate ventilation.
   Avoid prolonged contact with skin. Do not take internally.
   Flush exposed area-get medical advice.

8. Carbon Dioxide-Solid (Dry Ice)
   Warning
   Extremely cold (109°F below 0). Causes severe burns.
   Liberates heavy gas which may cause suffocation.
   Do not get on skin or hands.
   Do not put in closed container.
   Do not enter areas where stored until properly ventilated.
   Do not taste.
   Treat as a burn-get medical help.

9. Ether
Danger
Extremely flammable-highly volatile.
Keep away from heat, sparks, and flames.
Keep in closed container.
Do not allow to evaporate to near dryness. Add water or reducing agents to lessen peroxide formation.
Should be discarded after use-do not store for use next year.

10. Hydrochloric Acid (Muriatic Acid)
Warning
Causes burns.
Avoid contact with skin and eyes.
Avoid breathing vapor.
Immediately flush for 15 minutes.
Get medical attention for eyes.

11. Hydrogen Peroxide (7.4% or 25% volume)
Caution
Strong Oxidant
Avoid contact with skin and eyes. Wear rubber gloves and goggles.
Avoid contamination from any source-metals, dust, etc.
Store in original closed container.
Do not add any other product to container.
When empty, rinse thoroughly with clean water.

12. Mercury
Warning
Vapor, liquid.
Avoid breathing vapor.
Get medical attention if inhaled or swallowed.

13. Alcohol - ISOPROPHYL
Caution
Flammable
Gas or vapor is an irritant and narcotic.
Handle as toxic.
Keep away from flame.
Avoid breathing.
Get medical advice if consumed.

14. Paint Thinner-Turpentine
Caution
Flammable
Toxic
Keep away from sparks.
Flush area, get medical advice.

15. Iodine
Warning
Gas or vapor irritant.
Causes skin irritation or burn.
Avoid contact with combustible materials.
Keep away from fire.
Flush area, get medical advice.

16. Methyl Celulose-Chemical source book
No immediate danger unless consumed in quantity.

17. Plaster of Paris (Calcium Sulfate)
No immediate danger.

18. Napthalene (Moth Balls)
Caution
Flammable
Gas or vapor is toxic.
Keep away from sparks-open flame.
Avoid inhalation.
Get medical aid if swallowed.

19. Ammonium Hydroxide
Warning
Toxic
Avoid contact with eyes, skin, and clothing.
Use adequate ventilation.
Flush area, get medical attention.

20. Sulfuric Acid (Battery Acid)
Warning
Oxidizing material.
Gas or vapor is toxic.
Causes skin irritation or burn.
Avoid contact with combustible materials.
Avoid contact with skin, eyes and clothing.
Flush area, get medical attention.

21. Magnesium Ribbon
No hazard when by self.
Harmful radiation when burning-do not look at it.
Get medical advice if eyes are exposed.

22. Baking Soda (Sodium Bicarbonate)
No hazard.

23. Freon 11, 12
Not toxic.
Cold
Do not expose to skin, etc.
Treat as a burn, get medical advice.
Potential environmental hazard!

24. Copper Sulfate
Caution
Toxic
Avoid contact with skin, eyes and clothing.
Handle as toxic.
Get medical advice, flush area.

25. Stains ESY -- No hazard in dilute solution.
EDSIN

9. Ether
Danger
Extremely flammable-highly volatile.
Keep away from heat, sparks, and flames.
Keep in closed container.
Do not allow to evaporate to near dryness. Add water or reducing agents to lessen peroxide formation.
Should be discarded after use-do not store for use next year.

10. Hydrochloric Acid (Muriatic Acid)
Warning
Causes burns.
Avoid contact with skin and eyes.
Avoid breathing vapor.
Immediately flush for 15 minutes.
Get medical attention for eyes.

11. Hydrogen Peroxide (7.4% or 25% volume)
Caution
Strong Oxidant
Avoid contact with skin and eyes. Wear rubber gloves and goggles.
Avoid contamination from any source-metals, dust, etc.
Store in original closed container.
Do not add any other product to container.
When empty, rinse thoroughly with clean water.

12. Mercury
Warning
Vapor, liquid.
Avoid breathing vapor.
Get medical attention if inhaled or swallowed.

13. Alcohol - ISOPROPHYL
Caution
Flammable
Gas or vapor is an irritant and narcotic.
Handle as toxic.
Keep away from flame.
Avoid breathing.
Get medical advice if consumed.

14. Paint Thinner-Turpentine
Caution
Flammable
Toxic
Keep away from sparks.
Flush area, get medical advice.

15. Iodine
Warning
Gas or vapor irritant.
Causes skin irritation or burn.
Avoid contact with combustible materials.
Keep away from fire.
Flush area, get medical advice.

16. Methyl Celulose-Chemical source book
No immediate danger unless consumed in quantity.

17. Plaster of Paris (Calcium Sulfate)
No immediate danger.

18. Napthalene (Moth Balls)
Caution
Flammable
Gas or vapor is toxic.
Keep away from sparks-open flame.
Avoid inhalation.
Get medical aid if swallowed.

19. Ammonium Hydroxide
Warning
Toxic
Avoid contact with eyes, skin, and clothing.
Use adequate ventilation.
Flush area, get medical attention.

20. Sulfuric Acid (Battery Acid)
Warning
Oxidizing material.
Gas or vapor is toxic.
Causes skin irritation or burn.
Avoid contact with combustible materials.
Avoid contact with skin, eyes and clothing.
Flush area, get medical attention.

21. Magnesium Ribbon
No hazard when by self.
Harmful radiation when burning-do not look at it.
Get medical advice if eyes are exposed.

22. Baking Soda (Sodium Bicarbonate)
No hazard.

23. Freon 11, 12
Not toxic.
Cold
Do not expose to skin, etc.
Treat as a burn, get medical advice.
Potential environmental hazard!

24. Copper Sulfate
Caution
Toxic
Avoid contact with skin, eyes and clothing.
Handle as toxic.
Get medical advice, flush area.

25. Stains ESY -- No hazard in dilute solution.
EDSIN

26. Methyl Alcohol
Caution
Flammable
Gas vapor is narcotic, toxic.
Avoid contact with skin and eyes.
Keep away from fire.
Get medical advice if swallowed or exposed to eyes.

27. Sodium Hydroxide (Lye)
Caution
Causes skin irritation or burns.
Toxic.
Avoid contact with moisture, acid.
Avoid contact with skin and eyes.
Handle as toxic.
Flush area, get medical advice.

28. Epsom Salts (Magnesium Sulfate)
No danger.

29. Benedict's Solution
Caution
Toxic
Avoid contact with skin and eyes.
Handle as toxic.
Flush area, get medical advice.

30. Food Coloring
Safe

31. Silica Gel (Crystal Garden Solution)
No hazard in weak solution.

32. Zinc
Avoid swallowing.

33. Methylene Blue
No hazard in weak solution.

References

Chemical Safety Slide Rule, National Safety Council, 425 N. Michigan Ave., Chicago, Illinois 60611.

"Dangerous Materials" (Charts), Janesville, Wi.: Science Related Materials, Inc., 1969.

Safety in the Science Laboratory, Tallahassee, Florida: State Department of Education, 1968.

"Safety Regulations for Science," Detroit Public Schools, 1968.

Appendix K

CHEMICAL CONTAINERS

Below is a partial list of recommended storage containers for common laboratory chemicals which may be used in a biology laboratory program at one time or another.

Flammable Liquids		Dangerously Corrosive Chemicals		
Benzol, Benzine	Tin Can	Glacial Acetic Acid	GSB	
Ether, Ethyl	Tin Can	Hydrocholoric Acid	GSB	
Acetone	Tin Can	Sulphuric Acid	GSB	
Alcohol, Ethyl	Tin Can	Sodium Hydroxide	GSB	
Alcohol, denatured	Tin Can	Potassium Hydroxide	GSB	
Alcohol, Methyl	Tin Can	Acid Chromic	GSB	
Amyl Alcohol	GSB	Acid Nitric	GSB	
Toluol or Toluene	Tin Can			
Xylol or Xylene	Tin Can	Peroxides and other oxidizing agents		
Glycerine	GSB	Hydrogen Peroxide	GSB	
		Potassium Permanganate	GSB	
Combustible Substances		Silver Nitrate	GSB	(Brown bottle)
Shellac	GSB			
Cotton Absorbent	Paper box	Other Metallic Nitrates	GSB	

(G.B.S-Glass Stoppered Bottles)

References for labeling chemical containers:

"Guidelines to Precautionary Labeling of Hazardous Chemicals" - Manual L-1, Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington D.C. 20009.

Appendix L

Wind Chill Chart-should be considered when taking field trip in winter:

It is of great importance that one subjected to cold be aware that the body is affected by a combination of wind and temperature. This has led to the formulation of the "Wind Chill Index." The U.S. Army Wind Chill Index shows that wind velocities do not have to be very great to cause extreme chilling. The National Safety Council states that the effects of cold can be minimized by wearing several layers of light clothing instead of one heavy layer. The trapped air acts as insulation. Also, use of clothing with venting decreases perspiration thereby preventing freezing. Clothing should be kept clean and dry.

If the exposed skin starts to tingle, the area may be rubbed; however, a numb area must not be rubbed. A numb area means that frost bite has set in and rubbing will damage the skin. Also, one should not rub the area with snow-this bruises the tissues and causes deeper freezing. In case of frost bite, the Council recommends that a physician be contacted and the victim be taken to a warm place. For frost bitten feet, carry the person--since walking on frozen feet causes greater injury. Water 110°F to 112°F can be applied to the frost bitten parts. While preparing the water, warm the area with a warm hand (not rubbing) or holding close to a fire. Blankets and a hot drink can be used to further warm the individual.

WIND CHILL CHART

Actual Thermometer Reading °C

Estimated Wind Speed KPH	10	5	-1	-7	-12	-18	-23	-29	-34	-40	-46
	Equivalent Temperature °C										
Calm	10	5	-1	-7	-12	-18	-23	-29	-34	-40	-46
8	9	3	-3	-9	-14	-20	-26	-32	-37	-43	-49
16	4	-2	-9	-16	-20	-29	-36	-43	-50	-56	-63
24	2	-6	-13	-20	-28	-37	-42	-50	-57	-64	-72
32	0	-8	-15	-23	-31	-39	-47	-54	-63	-70	-78
40	-1	-9	-18	-26	-34	-42	-50	-58	-66	-75	-83
48	-2	-11	-19	-28	-36	-44	-52	-61	-69	-78	-86
56	-3	-12	-20	-29	-37	-45	-54	-63	-72	-80	-89
64	-3	-12	-21	-29	-38	-47	-56	-64	-73	-81	-90

Wind speeds greater than 64 KPH have little additional effect.

Little Danger for Properly Clothed Person

Increasing Danger

Great Danger

Danger from Freezing of Exposed Flesh

WIND CHILL CHART

Actual Thermometer Reading °F

Estimated Wind Speed MPH	50	40	30	20	10	0	-10	-20	-30	-40	-50
	Equivalent Temperature °F										
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57
10	40	28	16	4	-9	-21	-33	-46	-58	-70	-83
15	36	22	9	-5	-18	-36	-45	-58	-72	-85	-99
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125
35	27	11	-4	-20	-35	-49	-67	-83	-98	-113	-129
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132

Wind speeds greater than 40 MPH have little additional effect.

Little Danger for Properly Clothed Person

Increasing Danger

Great Danger

Danger from Freezing of Exposed Flesh

Appendix M

Laboratory Activities With Radiation And Radioactive Materials

1. As radioactive materials are received, mark them as "RADIOACTIVE" and, if possible, give some indication of the level of radioactivity for that date.

2. Store radioactive materials in a locked cabinet that is clearly marked "RADIOACTIVE MATERIAL".

3. Avoid getting radioactive isotopes near the mouth, eyes, or open sores.

4. No eating, drinking, or use of cosmetics in the area.

5. Do not pipette radioactive solutions by mouth.

6. Avoid inhalation of fumes from reactions involving radioactive materials. Such reactions should be carried out under ventilating hoods.

7. Avoid contaimination of the hands. Use tongs or tweezers to handle solid specimens and plastic or rubber gloves for solutions. Wash hands after each experiment and test with a Geiger Counter. Contamination can be removed by scrubbing with a soft brush and soap for several minutes.

8. Spread waterproof paper over working area to simplify "clean-up".

9. Avoid spilling solutions or dropping specimens. If this does happen, check to see that some contamination does not remain.

10. Check area with Geiger Counter after clean-up.

11. If a student should bring in a radioactive specimen to the classroom or laboratory, check its level of activity to be certain that it is not dangerously high.

12. Disposal of small amounts of low activity isotopes (in the microcurie range) can be handled safely as follows:

    a. solutions may be diluted with large amounts of water and flushed down the drain.

    b. solid materials and trash may be incinerated without danger, if they are of low activity; however, the material should be checked to see that the activity is in the microcurie range.

    c. consult Atomic Energy Directives for disposal instructions of more active specimens.

Further information may be obtained from: The National Council on Radiation Protection and Measurements, P.O. Box 4867, Washington, D.C. 20008.

Science Advisory Committee
Curriculum Division
Michigan Department of Education
Lansing, MI 48902

Safety Education and Training Division
Bureau of Safety and Regulation
Michigan Department of Labor
300 East Michigan Avenue
Lansing, MI 48926

Appendix N

SAFETY EQUIPMENT AND FACILITIES

A. Introduction

The following is a summary of "Emergency Equipment and Clothing" from Safety in Academic Chemistry Laboratories, American Chemical Society.

B. Facilities and Safety Equipment - General Checklist

All chemistry labs should have:

____ 1. Safety showers.
____ 2. Dry chemical powder or carbon dioxide-type fire extinguishers.
____ 3. Fume hoods.
____ 4. Eye protection devices for students and staff.
____ 5. Eye wash facilities.
____ 6. An alarm for evacuating laboratory. (Readily accessible to instructors). It should sound only for lab concerned.
____ 7. Well marked, unimpeded exits.
____ 8. A general alarm system for the entire building.
____ 9. Provisions for safe storage and transportation of chemicals. (Incompatible chemicals should never be stored in close proximity).
____10. A carefully planned chemical disposal procedure. (Must follow EPA rules or other local, state and federal regulations). The following company will dispose of chemicals for schools: Nelson Chemicals, 12345 Shaefer, Detroit, MI, 933-1500.
____11. Protective clothing-lab aprons, coats, gloves made of a chemically inert material.
____12. First aid equipment with sufficient personnel trained in its use.
____13. A file of current safety publications. The file should be accessible to students and visitors. The instructor should encourage its use.

C. Emergency Equipment and Clothing

1. Eye Protection

a. Students must be provided with proper eye protection or required to provide their own. (glasses, goggles, face shields). Act No. 54 of the Public Acts of 1972. Enrolled Senate Bill No. 553.
b. Eye protective devices should be provided for visitors and personnel.
c. Contact lenses should be prohibited in the lab. If a chemical is splashed into the eye, it will become trapped under the lens and irrigation will be ineffective.
d. Devices should be sanitized after each use.

2. Eye Washes

a. Eye wash fountains should deliver a gentle flow of clean, aerated water.
b. A hand held eye wash spray with a 5-foot hose is more adaptable. Rubber tubing can be attached to a faucet for ready use. It may be used as an eye wash and as a head and body wash.
c. Eye wash devices should be flushed weekly.
d. Eye wash devices should not be located where they can be contaminated by wastes.
e. A 15 minute wash is recommended.

3. Fire Extinguishers

a. Extinguishers should be appropriate to the specific need. (An ABC type extinguisher is recommended for general use).
b. There should be at least one extinguisher for each work bench.
c. Extinguishers should be charged promptly after each use. (At least a 10-lb. charge).
d. At least one dry chemical powder-type extinguisher should be provided for back-up use.
e. Carbon tetrachloride and most other halohydrocarbons should not be used because of their hazards: toxicity of vapors, the decomposition products, and their chemical reactivity under fire conditions.
f. At least one fire blanket should be provided for ready use.

4. Refrigerators

a. Domestic refrigerators should not be used for chemical storage unless modified by removing sources of open electrical contacts (i.e., bulbs) and replacing the door closure with easily opened magnets.
b. In frost free refrigerators, bottom drain should be plugged to prevent spillage and vapors from coming in contact with the motor.
c. Food and chemicals should never be stored in the same refrigerator.
d. Stored chemicals must be securely closed and properly labeled.
e. A regular defrosting schedule should be maintained.
f. Old chemicals should be discarded.

5. Sinks

a. Lab sinks should have rubber or plastic mats in the sink and on the drain.
b. Each sink should have ample hot water and soap.
c. Drainage from lab sinks should be kept separate from sanitary drainage.

6. Safety Showers

a. The valve handle should be rigidly fixed and plainly labeled.
b. The valve should readily open in either direction and remain open until intentionally closed.
c. Water flow must be sufficient to drench the subject rapidly.
d. Shower area must be free from obstructions.
e. Pure, tempered water should be used.
f. Showers should be tested on a regular basis. A record should kept of such tests.

7. Aspirators

a. Aspirators or aspirator bulbs should be used for drawing liquids into pipettes; never use the mouth.

Reference:

Safety in Academic Chemistry Laboratories, American Chemical Society, Committee on Chemical Safety, March, 1974, Revised January, 1976.

Appendix O SUGGESTED CIENCE SAFETY CHECK LIST

SCIENCE TEACHER _____ SCHOOL _____

DATE _____

Any condition in-operative is considered unsafe. Check (✓) those items and location not safe and submit copies to the person(s) designated by your local school division.

ITEM	LOCATION: CLASSROOM#	LABORATORY#	STORAGE ROOM#
Door(s)			
Windows			
Floor			
Cabinet(s)			
Shelving			
Ventilation			
Lighting			
Heat (Above 25°C)			
Water			
Waste Drain			
Fire Extinguisher			
Safety Shower			
Fire Blanket			
Eye Wash			
First Aid Kit			
Fume Hood			
Student Lab Station			
Instructor Preparation Station			
Instructor Demonstration Desk			
Master Water Cut-Off Valve			
Master Electric Cut-Off Switch			
Master Gas Cut-Off Valve			
Chemical Reagents			
Disposition of Unlabeled Materials			
Disposition of Unuseable Equipment			
Glassware			
Disposition of Hazardous Materials			
Other			

Comments:

Reference

Science Safety, Division of Secondary Education, Department of Education, Richmond, Va. July, 1976.

Appendix P

OAK PARK HIGH SCHOOL
LABORATORY SAFETY RULES
BIOLOGY

1. Protective glasses are required. You will not be permitted in the laboratory without them.
2. Some sort of laboratory apron or coat is recommended to protect you and your clothing.
3. No running or shouting is permitted in the lab.
4. Long hair must be secured away from your face and lab materials, especially chemicals and burners.
5. You should know the location, and how to use the fire extinguisher and fire blanket.
6. Always add acids to water, never water to acids when doing experiments.
7. Never return unused chemicals to stock bottles unless specifically instructed to do so by your teacher.
8. Throw solids into containers or waste baskets as directed by your teacher.
9. Always lubricate glass tubing or any other materials before inserting them into a stopper. Always wrap toweling around the tubing while inserting it into stoppers.
10. Be very cautious when using materials that give off an odor. Use hoods whenever poisonous or irritating fumes are evolved.
11. Never leave anything unattended while it is being heated, or is reacting rapidly. Do not leave bunsen burners burning unnecessarily. Do not leave gas generators alone or operating after the desired gas has been collected. Do not use burners when they are not needed.
12. Makeshift equipment and set-ups are the first steps to an accident, avoid using them.
13. A clean lab is a safe lab-return all materials to the proper place and keep your work area clean.
14. At all times concentrate on what you are doing.
15. Report any accidents to the teacher at once.
16. Students are not permitted in the labs without teacher supervision.
17. No food may be brought into the lab.
18. No smoking is permitted in the lab.
19. You should know and understand the dangers and hazards of each experiment before you start the experiment.
20. You should not do anything that will put another member of the class in a position of danger.
21. Do not taste any materials unless specifically instructed to do so by your teacher.
22. Wash your hands after using biological and chemical materials.
23. Do not use any lab materials, such as scalpels or scissors in any manner that would be dangerous to yourself or any other member of the class.
24. Do not operate the microscopes in any manner that could cause an electrical shock.
25. Do not take any biological or chemical materials out of the lab unless specific permission has been granted by your teacher.

I have read the above safety rules for Biology. I understand what they and my teacher had discussed them with the class.

Class	Date	Student's Name

Teacher - Hour

Appendix Q

Sample Science Class Safety Agreement

Science Class Safety Agreement

Students will be removed from the science activity area by the teacher if:

1. Their personal appearance or dress is such that they can cause injury to themselves, or to other students.
2. They are behaving in such a manner that they can cause injury to themselves, or to other students.
3. They are not following the prescribed safety rules for the science activity area, or the particular science activity being conducted.
4. They are going beyond the limits of the science activity into areas that may lead to an unsafe situation.
5. They have not completed the pre-experiment activities that will allow them to work safely in the laboratory situation.

I _____ have read the above rules. I understand what they mean and was
Student Name

in class when they were discussed by my teacher, or I had the teacher explain them to me.

I _____ have read the above rules. I have discussed them with my child and
Parent/Guardian

feel that my child understands what they mean and the consequences from removal from class. I would like to inform the school that my child has the following physical or medical situations that could affect his learning in a science class:

1. _____
2. _____
3. _____
4. _____

I _____ have received a signed copy of this form from _____
Teacher's Signature — Student Name

on _____. A copy of this agreement was give to the student, and a copy put in my
date

files.

Appendix R

SUPPLIERS FOR SAFETY EQUIPMENT & SERVICES

Abso-Clean Chemical Company
17325 Lamont
Detroit, Michigan 48212
(Cleaning Chemicals & Equipment)

Aden Supply Company
5706 W. River Drive, N.E.
Belmont, Michigan 49306
(Safety Glasses)

Advertisers Publishing Company
944 Wall Street, P.O. Box 602
Ann Arbor, Michigan 48107
(Custom imprinted safety awards)

Airkem Detroit, Inc.
404 West Eight Mile Road
Ferndale, Michigan 48220
(Odor Control)

The Ansul Company
16115 Meyers Road
Detroit, Michigan 48235
(Fire Protection Products)

Argus Supply Company
5940 Casmere
Detroit, Michigan 48212
(Ind. Safety & Fire Equipment)

A.J. Baxter & Company
10171 W. Jefferson
River Rouge, Michigan
(Industrial Safety Products)

Averill Equipment Company
19225 Conant Avenue
Detroit, Michigan 48234
(Safety Distributor)

Bemis & Son, Inc.
P.O. Box 151
Kalamazoo, Michigan
(Traffic Control)

Boyer Campbell & Sales
19460 Charleston
Detroit, Michigan 48203
(Safety Products)

Broner Glove Company
345 E. 9 Mile Road
Ferndale, Michigan 48220
(Industrial Work Gloves)

Contractor Machinery Company
13200 North End Avenue
Detroit, Michigan
(Construction Equipment)

Dockson Corporation
3839 Wabash Avenue
Detroit, Michigan 48208
(Head & Eye Protection)

Goodall Rubber Company of Michigan
13351 Cloverdale Avenue
Oak Park, Michigan 48237
(Industrial Rubber Goods)

Hastings Fiber Glass Products
770 S. Cook Road, Box 218
Hastings, Michigan 49508
(Hot Line Maintenance Tools)

Howe Services, Inc.
National Bank Building
Birmingham, Michigan 48011
(Message Motivation Programs)

Hy-Test Divison, International Shoe Co.
32302 Craftsbury
Farmington, Michigan
(Safety Shoes)

Jackson Products
5523 E. Nine Mile Road
Warren, Michigan 48091
(Safety Equipment & Welding Accessories)

Magline, Inc.
503 S. Mercer Street
Pinconning, Michigan 48650
(Magnesium Safety Blocks for Presses)

Mine Safety Appliances Company
19725 Ralston
Detroit, Michigan
(Safety Equipment)

National Safety Products, Inc.
116 North Hamilton Street
Saginaw, Michigan 48602
(Industrial Safety Equipment)

Port Products, Inc.
325 Main Street
Munith, Michigan
(Signs and Safety Equipment)

The Protectoseal Company
Power Materials Company
633 New Center Building
Detroit, Michigan 48202
(Safety Containers)

R-J Distributing Company
11566 E. Nine Mile Road
Warren, Michigan 48089
(Reynolds Televator-Power Scaffold)

Safeco, Inc.
24292 Gibson Drive
Warren, Michigan 48090
(Industrial Safety)

Safety Products & Services, Inc.
184 Avenue A
Battle Creek, Michigan 49015
(Safety Equipment(Sales & Service)

Safety Services, Inc.
407 East Michigan Avenue
Kalamazoo, Michigan 49006
(Industrial Safety Equipment Supplies)

Seco Manufacturing, Inc.
4461 W. Jefferson
Detroit, Michigan
(Safety Equipment and Supplies)

Speidel Safety Service
600 W. Commerce Road
Milford, Michigan 48042
(Industrial Safety Sales)

Standard Glove Company
28252 Terrace
Livonia, Michigan 48154
(Safety Gloves)

Stewart Oxygen Service
19142 James Couzens Highway
Detroit, Michigan 48235
(Oxygen Therapy Equipment)

Sugar Beet Products Company
302 Waller Street
Saginaw, Michigan 48605
(Industrial skin cleansers & medicated skin cream)

Tool Sales Company
46 Victor Avenue
Highland Park, Michigan 48203
(Safety Tools)

Wallace Optical
2870 E. Grand Blvd.
Detroit, Michigan
(Safety Glasses)

Wallace Opticians
107 N. Washington Avenue
Lansing, Michigan 48933
(Prescription Safety Glasses)

E.L. West Company
1020 E. Jolly Road
Lansing, Michigan 48910
(Construction Safety)

LeHigh Safety Shoe Company
14234 Woodmont Road
Detroit, Michigan 48227

Midwest Safety Supply
621 Liberty Street
Jackson, Michigan 49203
(Industrial Safety Equipment)

Fisher Scientific Company
711 Forbes Avenue
Pittsburgh, Pennsylvania 15219

Sargent Welch Scientific Company
7300 North Linden Avenue
Skokie, Illinois 60076

Turtox/Cambosco
Macmillan Science Company, Inc.
8200 S. Hoyne Avenue
Chicago, Illinois 60620

Science Kit, Inc.
777 East Park Drive
Tonawanda, New York 14150

Central Scientific Company (CENCO)
2600 South Kostner CENCO Center
Chicago, Illinois 60623

Safety Education & Training Division
Bureau of Safety & Regulation
Michigan Department of Labor

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